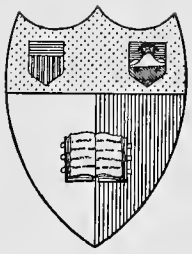
THE AMERICAN CAR AND FOUNDRY COMPANY IN KHAKI



THE AMERICAN CAR AND FOVNDRY COMPANY IN KHAKI

WILLIAM H. WOODIN PRESIDENT

THE AMERICAN CAR AND FOVNDRY CO. IN KHAKI

Its Production Achievements in the Great War

THE AMERICAN CAR AND FOVNDRY COMPANY
165 BROADWAY, NEW YORK
NEW YORK
NINETEEN HVNDRED AND NINETEEN

WILLIAM M. HAGER
ASSISTANT TO PRESIDENT

WILLIAM C. DICKERMAN
VICE-PRESIDENT IN CHARGE OF WAR DIVISION

WILLIAM F. KINGSTON
VICE - PRESIDENT

WILLIAM F. LOWRY
DISTRICT MANAGER

FRED A. STEVENSON
ASSISTANT GENERAL MANAGER

FRANK FAUST
ASSISTANT DISTRICT MANAGER

HERBERT W. WOLFF
VICE-PRESIDENT

JAMES M. BUICK
VICE-PRESIDENT AND GENERAL MANAGER

A.E. OSTRANDER
GENERAL MECHANICAL ENGINEER

Foreword

Foreword

By

The Chief of Ordnance

The war record of American industry is a complex story of which one man may write but a little part. It is a wonderful story—a fitting complement to the record of deeds of our heroic fighting men. It is a history of achievement that this generation may well feel proud to pass on to posterity and of which the wonder and appreciation will continue to increase as the herculean nature of the task becomes more apparent with time.

The American Army Ordnance Department, in this world war, functioned chiefly to coordinate the activities of the thousands of munition manufacturing plants extending over the breadth and length of our country. Modern war has outgrown arsenals and reaches with its demands into every city, town and hamlet, into almost every store, factory and shop. American manufacturers and the American Ordnance Department faced, side by side, the task of forging and forming from the fire and steel of united American industry a weapon suitable for the successful wielding of the American fighting giant of three million manpower.

In trying to visualize the scope and magnitude of American Ordnance work, I sometimes picture it as a river of human effort. Branches and tributaries almost innumerable flowed from every locality in America into the main stream, each branch, however small, adding to the general level. There is something almost overwhelming in the thought of the potentialities possessed by this great silent, swiftly moving river of human energy, the sole purpose of whose power was to overwhelm autocracy. Can any one conceive an outpouring of human energy capable, if used for that purpose, of building a Panama Canal every thirty days, or a city of New York every year? Yet this was the rate of flow of human energy as applied in the United States to Army Ordnance work.

It was the task of the Ordnance Department to map the channel for this great

river, to take soundings of its depth and to measure its rate of flow, to watch constantly for eddies, whirlpools and stoppages and to search continuously for new tributaries. But it was the far greater task of American industry to fill this channel to overflowing with a rushing stream of energy and accomplishment.

Even those of us whose daily task was to sound and measure the main stream of ordnance effort found it difficult to visualize with our finite minds the depth or breadth or swiftness of this great river. And so one must, if he would have knowledge of these things, turn his thoughts away from the main stream and study the tributaries that made the main stream possible.

The American Car and Foundry Company, with its vast organization and widely distributed plants, was one of these great tributaries. I am glad that the history of its able war efforts has been written. It is a difficult task to convey an adequate image even of a tributary when it was one of such volume as to have carried into the main stream of accomplishment the millions of shells, the thousands upon thousands of artillery vehicles and the many other vital items chronicled in this volume.

I take pleasure in repeating here what I said to Mr. Woodin in January, 1919, that it is indeed gratifying to me to be able to compliment him, his associates and the entire organization of his company on such successful performance in the execution of war contracts. Every executive, employee and stockholder in the organization may justly feel proud of the part played by "The American Car and Foundry Company in Khaki."

Major General, Chief of Ordnance, U.S.A.

Introduction

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ORDNANCE
WASHINGTON

January 9, 1919

Mr. W. H. Woodin, President,
American Car & Foundry Co.,
165 Broadway, New York, N.Y.

My Dear Sir:

I desire to express to you appreciation of the hearty co-operation and the valuable assistance the Ordnance Department has received from your Company in supplying the artillery vehicles and artillery ammunition requirements of the Army.

It is gratifying to me to be able to compliment you, your associates, and the entire working organization of your company on such successful performance in the execution of your contracts.

I extend to you all my best wishes for your future success.

Respectfully,

Major General, Chief of Ordnance, U.S.A.

Of all the commendations ever received by this company, Major General Williams' is the most deeply appreciated, setting, as it does, the seal of our Government's approval on our record and richly rewarding every man and woman in our organization who had to do with the making of that record. For the high honor it does them and our Company the communication is here repeated.

Introduction

In the general office of our Company, framed and in positions of prominence, are two communications of which I am very proud. One is the letter from Major General C. C. Williams which appears on the opposite page; the other is a telegram reading as follows:

Atlantic City, N. J., April 1, 1917.

W. H. Woodin, President,
American Car and Foundry Co.,
165 Broadway, N. Y. C., N. Y.

Delighted to hear you have successfully completed your contract. Heartiest congratulations.

E. R. STETTINIUS.

While General Williams' letter of appreciation sets the official seal of Government approval on our war record and is the Company's honorable discharge from American war service, Mr. Stettinius' telegram is an emblem that represents the successful completion of our munition apprenticeship before America entered the war. When Germany invaded Belgium and the greatest war in history became inevitable, it was decided, after consultations and deliberation, that the American Car and Foundry Company should embark in the manufacture of projectiles. An order for 3-inch shells from the Russian Government was accepted and the work was assigned to the Berwick plant.

The production of these Russian shells was under way when Great Britain's demands upon the resources of the United States became insistent. To meet these demands, the Car Company organized its Detroit plant and manufactured 9.2-inch and 8-inch Howitzer shells and forgings.

The successful quantity production of the larger sizes of British shells to meet the deliveries specified demanded the immediate solution of many hitherto unsolved problems. It involved a manufacturing proposition almost entirely new; there were no precedents to follow and no experts or trained and experienced mechanics in this

line to call upon; even the machine equipment and shop layout necessary for maximum output were not, and could not be, under the circumstances, absolutely predetermined. It is a simple matter to forge and machine a few sample shells, but we had definitely committed ourselves to furnish a tremendous quantity within a fixed period, none too long under favorable conditions. While of course this had not been done without most careful consideration, it was an anxious time for all concerned, but our organization successfully overcame the difficulties, foreseen and unforeseen, and we finished with flying colors, as Mr. Stettinius' telegram so eloquently attests. (Mr. Stettinius' at that time, it will be remembered, was responsible to the British Government for supplying its army with all the shells that could be had in this country.) It gives me pleasure to say that from the beginning he had confidence in us, and more pleasure to add that it was not misplaced.

It was our experience with these contracts that, when our Government entered the war, gave us the confidence to accept with reasonable assurance the responsibility placed upon us of producing our share of the enormous quantities of ordnance supplies required by our war program. To meet the situation it was necessary to reframe our organization.

Two distinct divisions were organized. One, known as the Car Division, was placed under the direction of James M. Buick, Vice-President and General Manager, and was devoted to the building of railroad cars for the United States Government, its Allies, and the Military Railways in France. The other was known as the War Division, over which Vice-President William C. Dickerman was given general charge, with Assistant General Manager Frederick A. Stevenson in charge of shop operation. This division gave its attention to the manufacture of ordnance materials for the United States Government War Department.

The soundness of this plan of organization was thoroughly demonstrated by the fact that from the outbreak of the war, in August, 1914, to the signing of the armistice, in November, 1918, the War Division delivered equipment and ordnance materials to the value of one hundred and forty-eight million dollars.

The Car Division made and delivered to the United States Government for the Military Railways in France, freight cars having an aggregate value of twelve million dollars.

At the same time, it manufactured and delivered to the Allies of the United

States freight cars aggregating in value seventeen and one-half million dollars. The largest single order for railroad cars ever awarded in the history of the world—31,000 freight cars—was placed by the U. S. Railroad Administration with the American Car and Foundry Company.

I esteem it a privilege to acknowledge our debt of gratitude to the officers of the Ordnance Department for the immeasurable and invaluable assistance freely given us. They were as eager to place at our disposal every helpful suggestion as we were anxious to have them. The bond of confidence firmly established between us was a prime factor in our success—a success that could not please us more than it pleased them. For—and this was the spirit of the whole enterprise—we were all Americans working together in a great and common cause.

In the glorious history of our Army and Navy during the Great War we proudly exult; and I am certain that the spirit of patriotism which animated our fighting forces was fully and completely shared by the army of producers at home, who were an essential part of the power devoted to the destruction of our enemies. To those of our men—and there were many—who disregarded their natural inclination to participate in direct military service, so that those who fought might not lack the things needed for their protection and to achieve victory, our particular thanks are due. They served faithfully where duty called; no higher commendation than this simple statement is possible.

Others saw their duty elsewhere and left us to serve with the colors; some of these made the supreme sacrifice and their names are enrolled on our tablet of honor and enshrined in the grateful memory of our country. In the honor we pay to them and to our fighting forces we cannot forget all who did their duty; and among these I place the men and women who made possible the record set forth in the following pages—the officers who planned and successfully prosecuted the work; the mechanics who with clear understanding of the emergency speeded production to meet the urgent need; and the stockholders of our Company whose savings made instant action possible.

The omission from the record of any further reference to the car building and other regular departments is by intention, as their activities involved no departure

from established lines. But the praise given the War Division is not at the expense of the other departments; these also deserve commendation for having, during a trying period accomplished highly creditable results, particularly in supplying the equipment so urgently needed by our Military Railways in France.

It was very gratifying to note during the several Liberty Loan and war charities drives, how generously our employees responded to these appeals; these matching the large subscriptions and contributions of our Company.

This book has been published so that our stockholders may have first-hand knowledge of our activities during the Great War. The results attained are simply typical of what American industry accomplished in that crisis.

It is hoped that the many friends of our Company who knew in a general way of the vast extent of our munition activities will find this review of interest; it is obvious that during the period of the war any publicity concerning the matter was clearly inadvisable, and it is not until now that we may freely inform them concerning our important part in the splendid service performed by American industry in a terrible emergency.

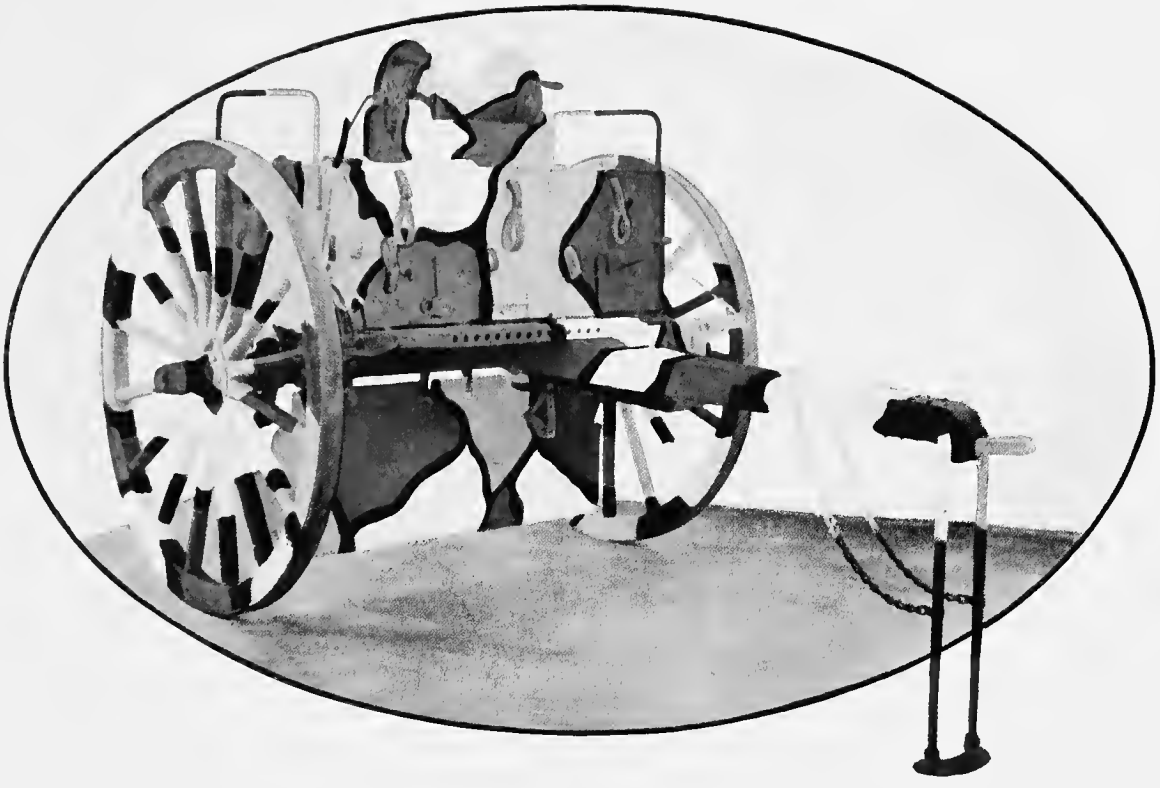
The pledge I gave our Government at the beginning of the war was:

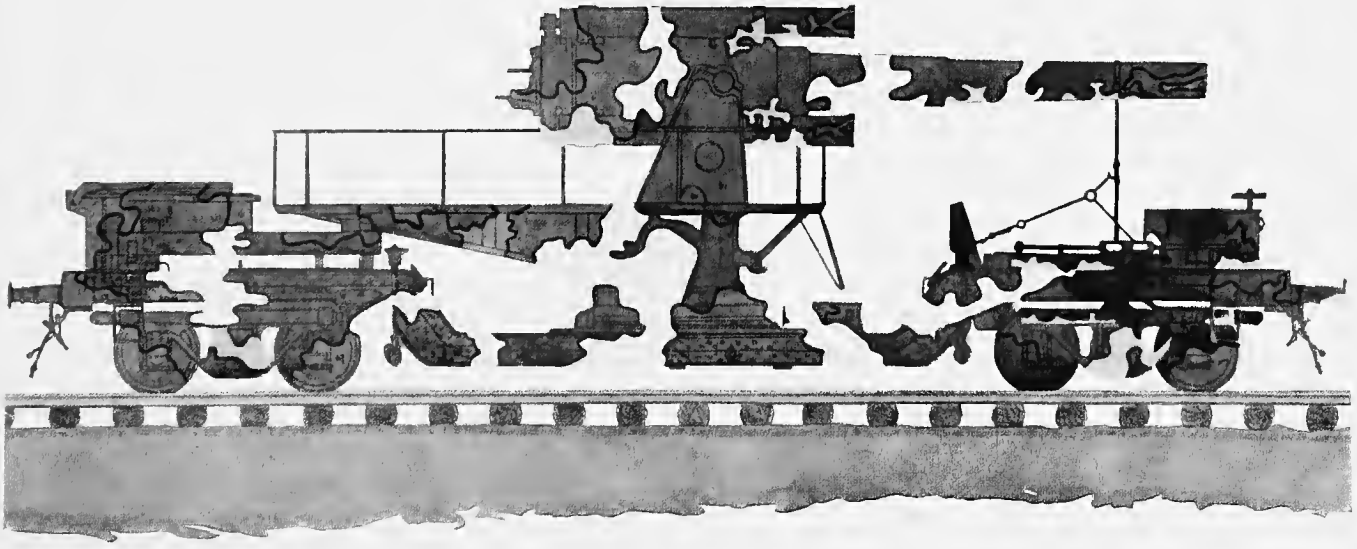
> *"I pledge the prompt production and delivery of the largest possible quantity of material in our Departments that is or shall be required by the United States Government for all necessities of itself and its Allies, and agree that all other lines of our business shall be subordinate to this pledge."*

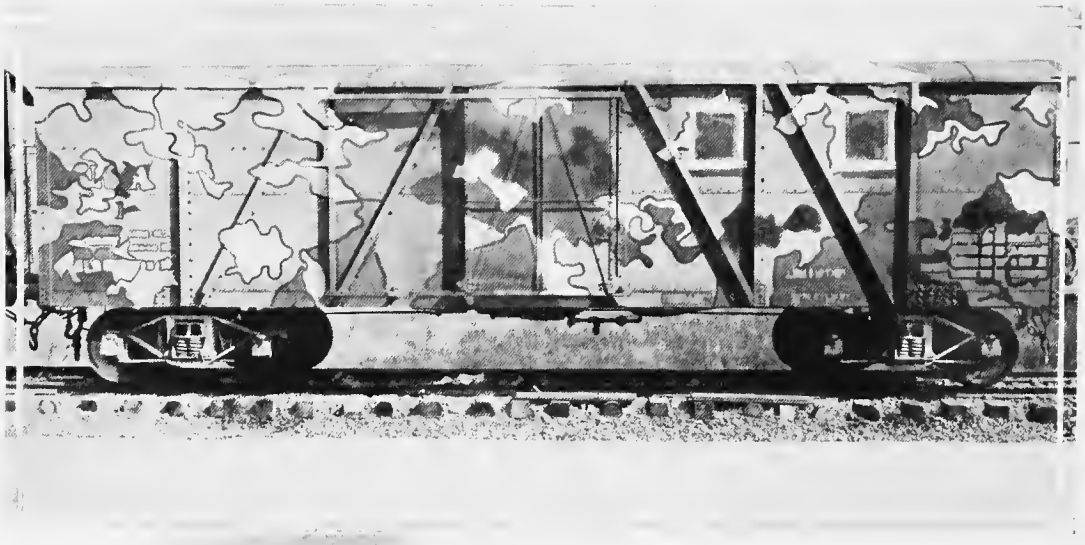
It is my profound conviction that this pledge was faithfully kept to the utmost ability of our Company and the men and women in its employ.

President.

New York, September 1, 1919.



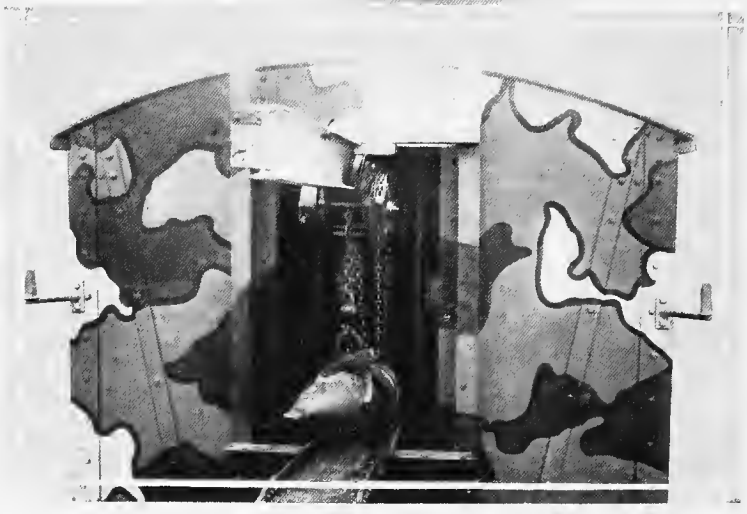




All Steel Ammunition Car, Camouflaged

Type of Car Used for Fire Control, Repairs and Spare Parts

Supply Car for Ammunition Train

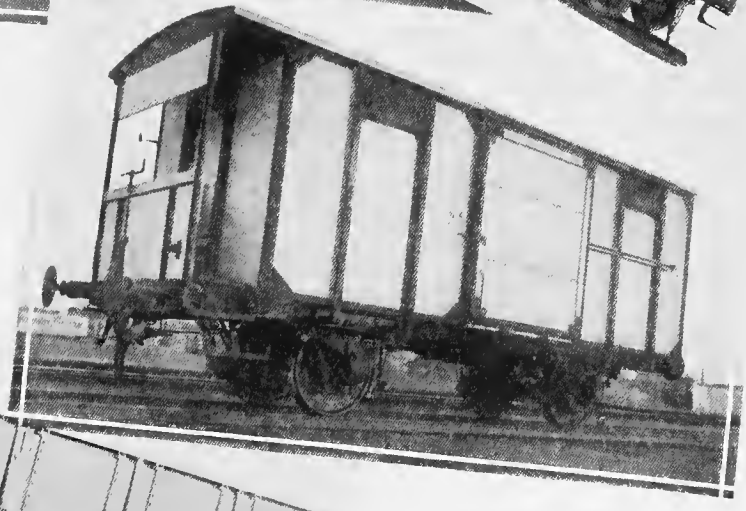


Passing Shell from Ammunition Car to Gun Car

Italian Gondola with
Brakeman's Cab

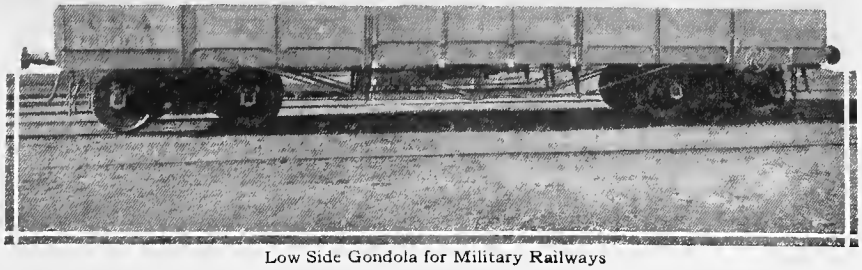
Box Car with Cab
for Military Railways

Tank Car for
Military Railways,
Narrow Gauge

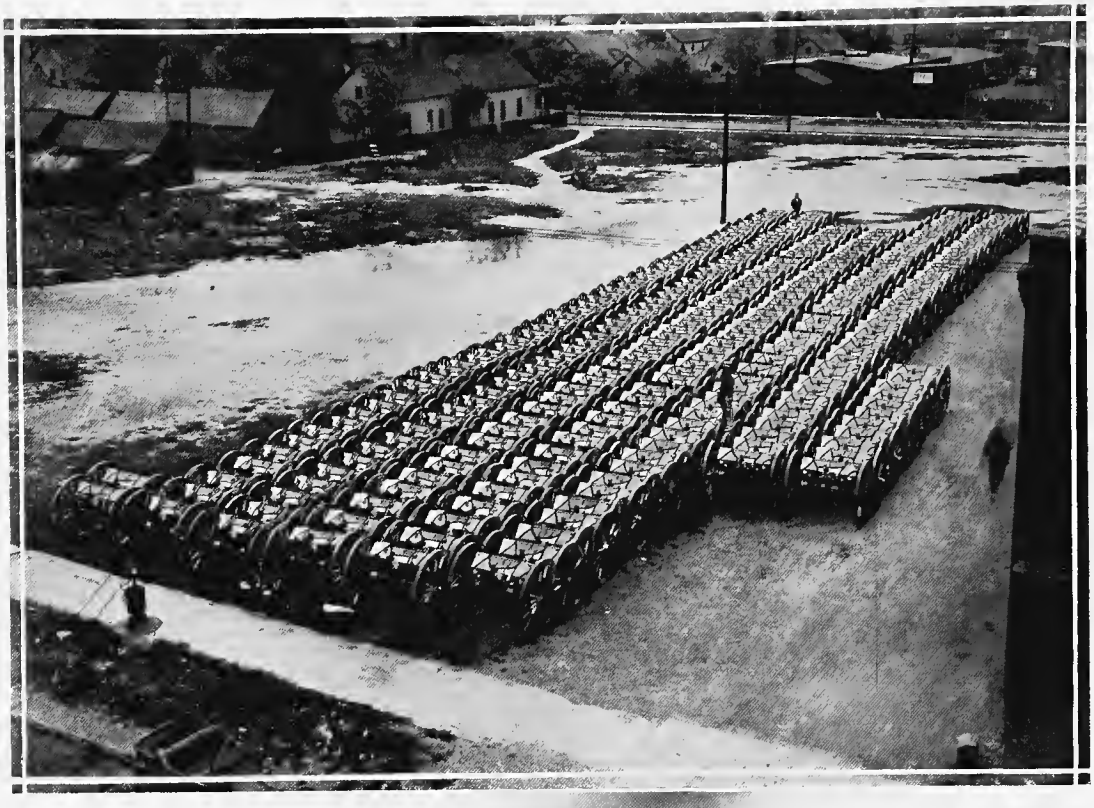


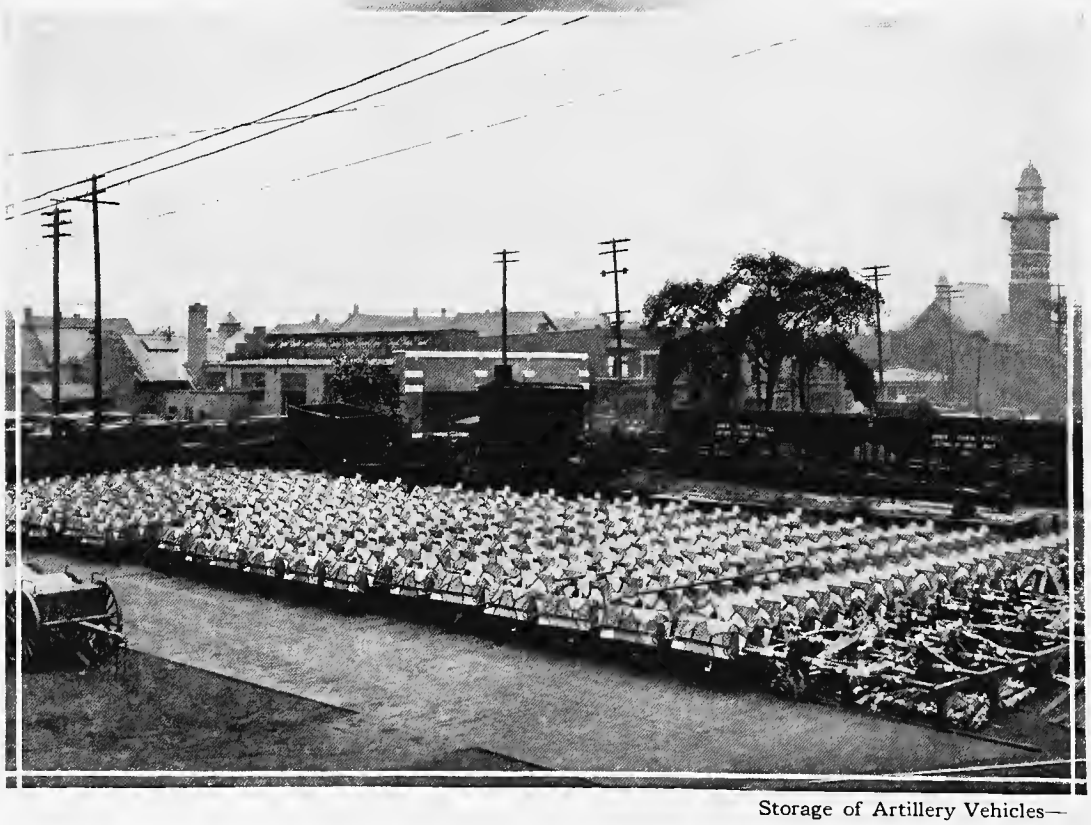
Russian Box Car
with Cab

Ballast Car for
Military Railways



Low Side Gondola for Military Railways



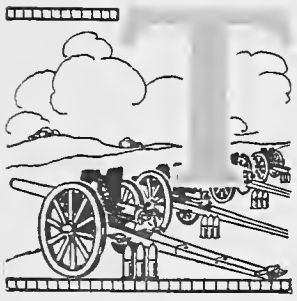


Storage of Artillery Vehicles—
Awaiting Shipping Instructions

SURVEYING THE INDUSTRIAL BATTLEFIELD

By MAJOR JOHN H. VAN DEVENTER

Editor of the *American Machinist*

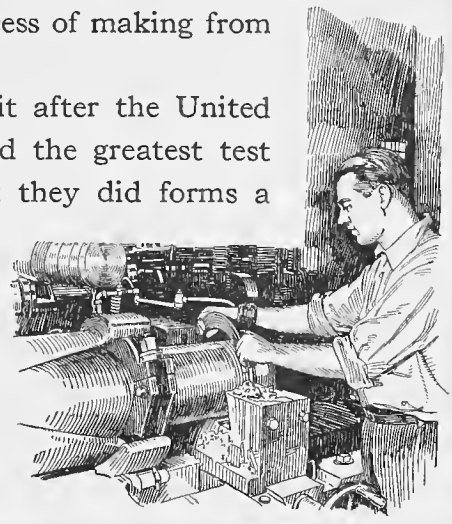


THERE is a close parallel between industrial institutions and individuals, for both have souls which stand revealed either in might or weakness when the emergency of war brings on its crucial test. The soul of a corporation cannot be measured merely by its dividends. It is a complex and composite spirit made up of the aspirations and abilities, the faith and honor, the determination and moral force of all of the employees, executives and stockholders. War tried the American shop in its crucible of fire just as it tried the American soldier.

World events plucked the untried American boy from his accustomed farm or factory. With no experience of war and with little military training, he was thrown head first into a seething vortex of activities that put the acid test to soul. The American boy made good. He went into the war a farmer, artisan, lawyer or clerk—he came out a hero.

When the American Car and Foundry Company put on its khaki it was in the same position as the American boy. It had yet to prove the real quality of its war mettle. For sixteen years its experience and efforts had been steadily applied to producing freight and passenger cars, forgings and other kindred lines far removed in nature and the process of making from munitions of war.

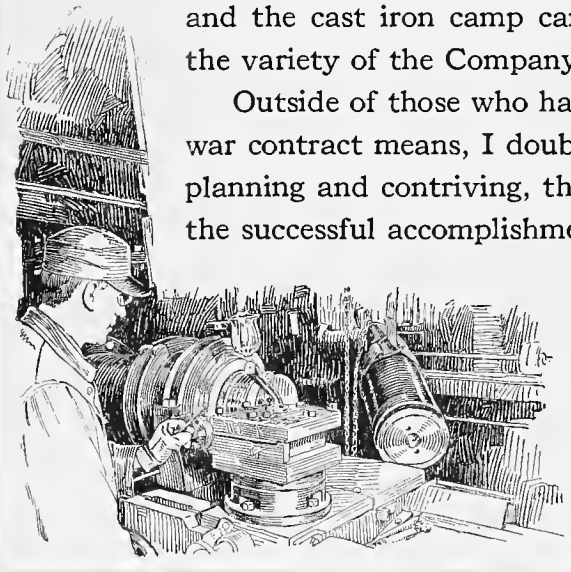
In meeting the tremendous burden placed upon it after the United States entered the war, American war industries faced the greatest test of corporate soul that has ever been applied. What they did forms a



story of achievement that would indeed be difficult to parallel in industrial annals.

It was not alone the *quantities* of munitions that were produced, although the realization of what such quantities mean taxes human comprehension. It was not alone the *quickness* with which these things were produced, although as you will see later, this quickness was astonishing. But he who understands the complexity and the difficulties of taking on new lines of manufacture, wonders most what magic wand of ability and effort enabled such plants, for example, as those of the American Car and Foundry Company, and these men fitted for and accustomed to building railway cars, to give birth to such a myriad progeny of munitions. Who would have believed that the doors of these shops which had for so many years opened to an output of cars and railway equipment could, in a period measured in months, swing wide for the egress of millions of shells, thousands upon thousands of gun carriage limbers, caissons, caisson limbers, battery wagons and forge limbers, motor trucks equipped as veritable moving repair shops, giant seven, eight and twelve inch railway guns, steel helmets, poison gas containers, submarine chasers, aeroplane trucks, powder and gun cotton storage cars, smoke stacks and pipes for cantonments, escort wagons, field kitchens, mess tables and mess stools, folding cots, cast iron candlesticks and hundreds of other different military appliances?

The list of material furnished by this Company is of almost extreme variety. These products contributed to the needs of nearly every branch of the American service, not only upon the battlefield in the shape of munitions; nor alone in appliances for military engineering, but also to the tent and the camp fire. What a contrast there is between the giant railway gun and the cast iron camp candlestick! It is a contrast that aptly pictures the variety of the Company's industrial war service.



Outside of those who have found by experience what the execution of a war contract means, I doubt if there is any real conception of the sleepless planning and contriving, the constant urging and striving that goes before the successful accomplishment of these highly forced activities. It needed

nerve to undertake a war contract; it required ability and persistence unmeasured to execute it. Necessity compels the time of delivery specified in a war contract to be based not upon probable or even possible accomplishment but upon impossibilities. Just as a soldier is expected to execute unheard of feats of bravery and endurance, so the manufacturer is called upon in time of war to accomplish the impossible. There is no more valued mark of appreciation that could have been given than that of the Chief of Ordnance when he congratulated the American Car and Foundry Company on having successfully executed its war contracts. For General Williams, above all others, knows what such accomplishment means.

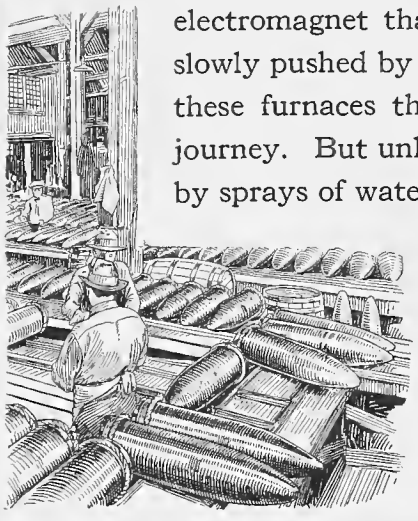
There are so many interesting incidents in this story of industrial achievement, that it is impossible to relate them all or to set them forth in any logical order. In the scope of this volume no pen could convey to you an adequate picture of them. What is attempted is to give you word pictures of a few of these activities so that you may clothe with reality and visualize the meaning of the many figures in the Statistical and Historical Notes, remembering each item that is briefly mentioned there has back of it an equally absorbing story of human endeavor.

FORGING THE THUNDERBOLTS OF WAR

FIRE and water must give birth to shell forgings before the hungry tools of a munition shop can eat their way through curling chips of steel. Many a munition plant fed its machines with forgings that a plant other than itself had made, but at Detroit, Depew and Berwick, the smithy fires of Vulcan ruled equally with the deities of metal cutting. Night and day, amid clouds of smoke and steam, lit up by fitful glares from glowing furnaces, and shot through with showers of sparks, the forge plants of the American Car and Foundry Company wrought these thunderbolts of war. They varied from the eighteen-pound three-inch Russian shell forging to the giant American ten-inch monster, three of which tipped the scale beams at a ton.

The popular conception of a forge shop pictures it peopled by human smiths whose swinging sledges are now and then abetted by a steam hammer. But no such puny means sufficed to forge the thunderbolts of war. The glowing ingot, coming white hot from its bath of fire, was thrust within the jaws of a gigantic press whose half-thousand ton grip compelled the reluctant metal to do its bidding. Two bites from the jaws of this giant and the hollow, cylindrical shell-forging was spewed out, still glowing, then carried on rollers to the place where it was given time to cool from its fever heat.

In the production of these great forgings the human hand had little to do other than to direct the shell along the changing path of its adventurous journey. Even the rough ingots were seized by the invisible fingers of an electromagnet that put them into the furnaces through which they were slowly pushed by another mechanism. Hell's fires could not be hotter than these furnaces through which the thunderbolts of war took their hour's journey. But unlike hell's fires the mouths of these furnaces were guarded by sprays of water to protect those who labored near them.



Rolling and Stacking
155 mm. Shell Forgings

Steel Billets Stored
to Make 155 mm.
Shell Forgings

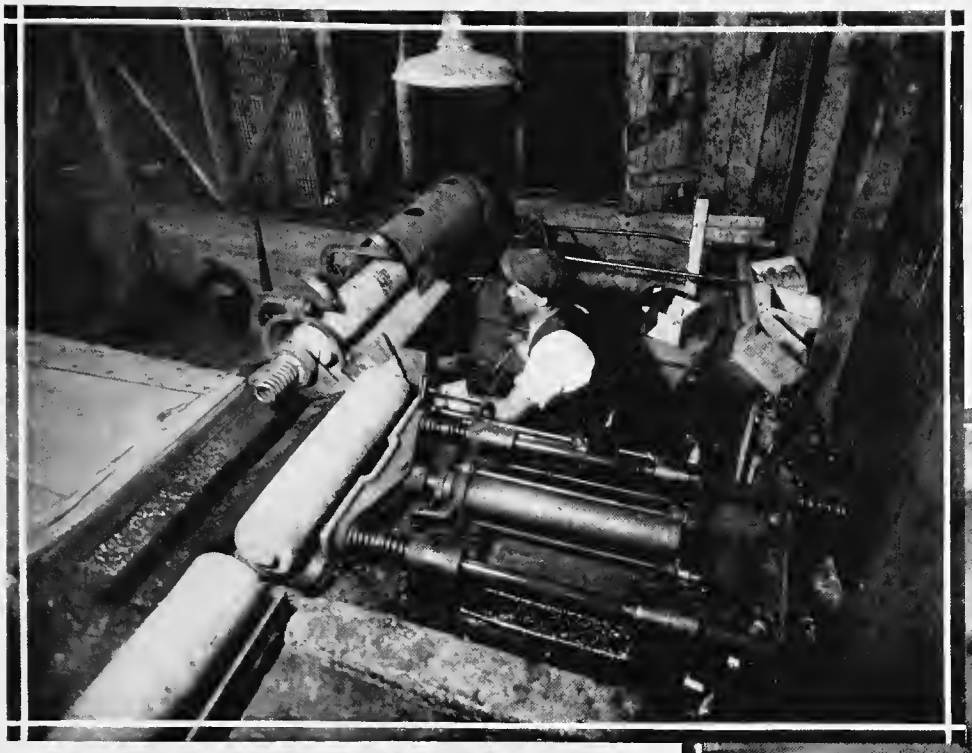
Painting 10-Inch Shells
Preparatory to Shipping
to Loading Plants

Storage of
155 mm. Shell Forgings

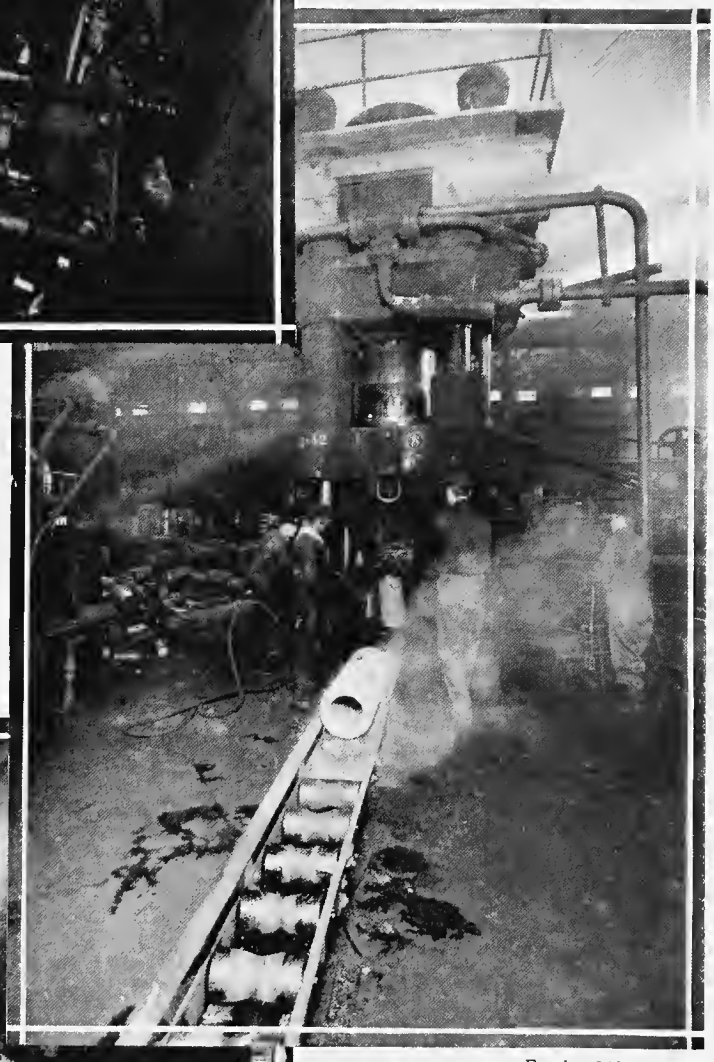
Storage of Steel Billets
in Steel Yard for
155 mm. Shell Forgings

Nicking of Steel Billets
by Means of Oxy-Acetylene
Torch Preparatory to
Breaking by Bulldozer

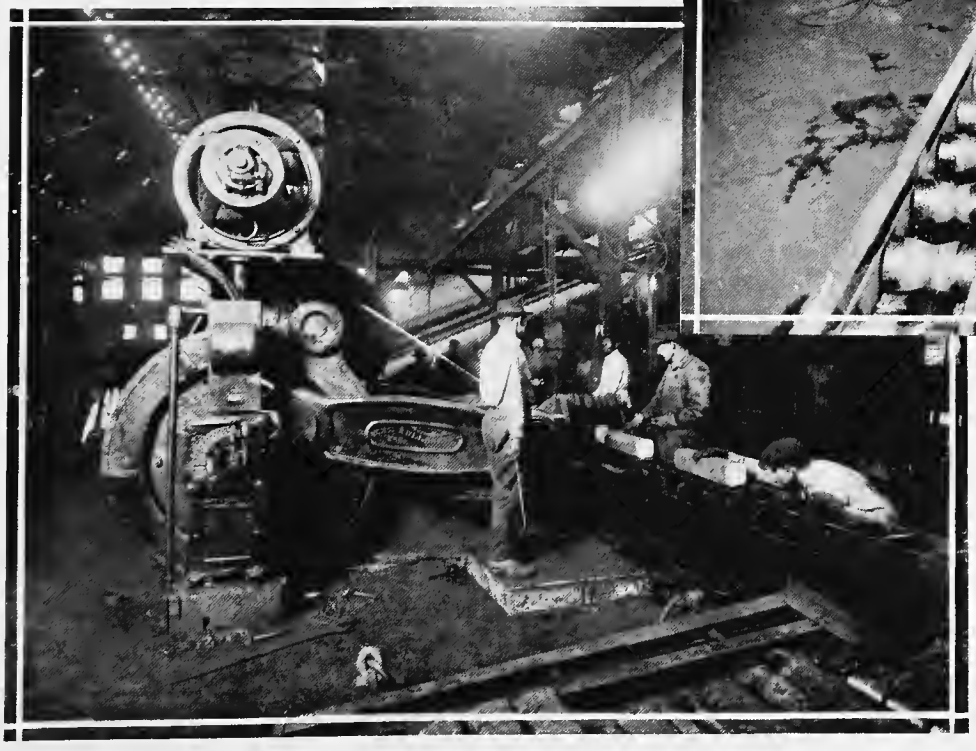
Storage of Steel Billets
in Steel Yard for
155 mm. Shell Forgings



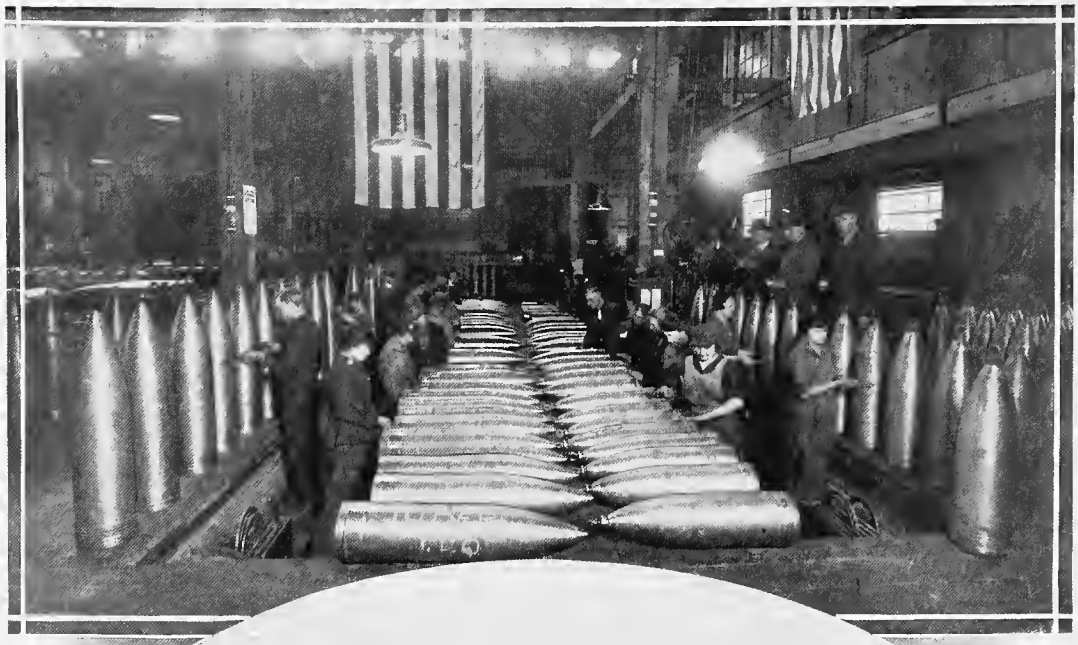
Testing Eccentricity
of 155 mm. Shell Forgings



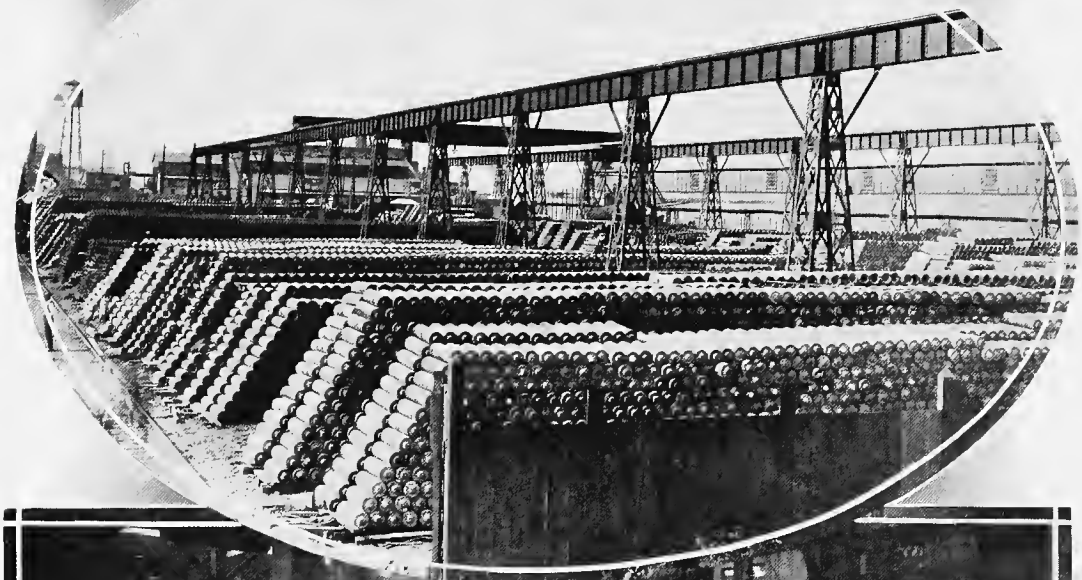
Forging 240 mm. Shells



Breaking Steel Billets
for 155 mm. Shells
by Means of a Bulldozer



Final Government Inspection of 10-Inch and 240 mm. Shells



240 mm. Shell Forgings

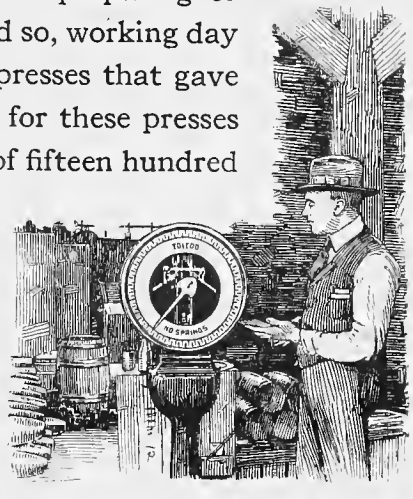
10-Inch Shells Ready for Painting

Constant vigilance guarded against defects from the time that the ingot bars were broken into billets until they completed their journey and were ready for the machine shop. Each shell had stamped upon its base a number which was to follow it thereafter to its completion and which gave it individual identity.

Starting work in November, 1917, by September, 1918, Detroit's daily average was sixty-two hundred forgings for the 155-millimeter shell with an occasional record of seven thousand; while Depew, making the same shell, two months later chronicled its red letter day with six thousand five hundred and seventy-five forgings. Each day Detroit and Depew added to the scales of war in shell forgings alone, the avoirdupois equivalent to a regiment of soldiers, and during the period of peak production the number of these one hundred and seventy-three pound shell forgings produced daily from the Company's war plants equalled the daily total of American soldiers going overseas.

The task faced by the American Car and Foundry Company was not simply that of sustained production, for once started, production became a matter of persistent driving force, the accumulated efforts of which built up remarkable records. But it was getting ready to start that required the almost superhuman effort—the developing and perfecting of the process, a tedious and trying task under the best of circumstances and particularly so when minutes and hours became as precious as ordinary days and weeks.

Detroit was the pioneer plant on heavy shell forging, and to Detroit must be given a large share of the credit for starting these great streams of metal on their way Hunward. For while Detroit was working out the process of making shell forgings for Uncle Sam on the presses which had been erected to produce the earlier British forgings, it was also preparing to produce these forgings fast enough to satisfy Pershing. And so, working day and night, Detroit's mechanics erected the four monster presses that gave these shells their shape. To provide the hydraulic power for these presses they installed pumps, some of them working to a pressure of fifteen hundred

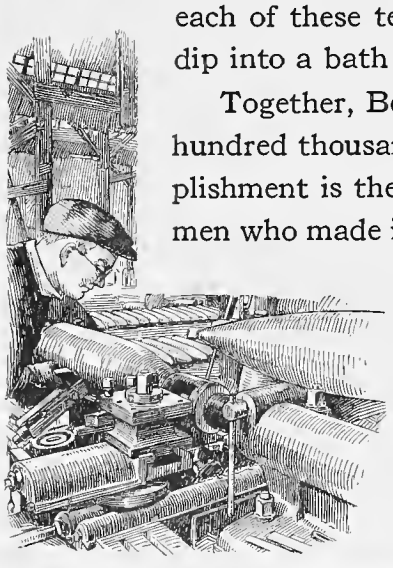


pounds to the square inch, and built an accumulator to steady the flow from pumps to presses of this enormous water pressure. Eight hundred and seventy-five thousand pounds of dense iron ore were loaded upon the ram of this accumulator to give it the necessary pressure. Eleven heating furnaces were installed in which to cook the metal meals with which to satisfy the hunger of these giant presses.

This first contract from Uncle Sam came in November, 1917, and three months later the production of forgings at Detroit was under way.

In the meantime, Depew was vigorously preparing to care for the forging of its quota of these thunderbolts. Excavating was started, concrete mixed, and foundations for heavy presses laid in the middle of Winter, at a time when the mercury hovered at nineteen degrees below zero. In a number of cases the frozen ground had to be blasted for laying drains and pipes and yet all of this work was carried on without interruption. While car-building machines, old trackage and pipes were being taken up, accumulators, hydraulic pumps, presses, and oil storage tanks were being installed. Depew completed its plant in four months, and eleven months thereafter had to its credit over six hundred thousand forgings.

Berwick's two and a half million of forgings for three-inch Naval shells represented a victory over peculiar difficulties. It was a notable achievement, for while these forgings were small compared with their giant brothers of Detroit and Depew, their very smallness introduced difficulties that were lacking in the larger shells. The tooth of the hydraulic press which bit a hole in this shell was so slender that it could barely stand the pressure, and so the engineers of Berwick devised an ingenious revolving arrangement which enabled six teeth to take the bite. They saw to it too that each of these teeth was toughened after coming from the hot metal by a dip into a bath of oil.



Together, Berwick, Depew and Detroit, forged over three million eight hundred thousand of these thunderbolts of war. The record of this accomplishment is the best monument to the energy, ability and ingenuity of the men who made it possible.

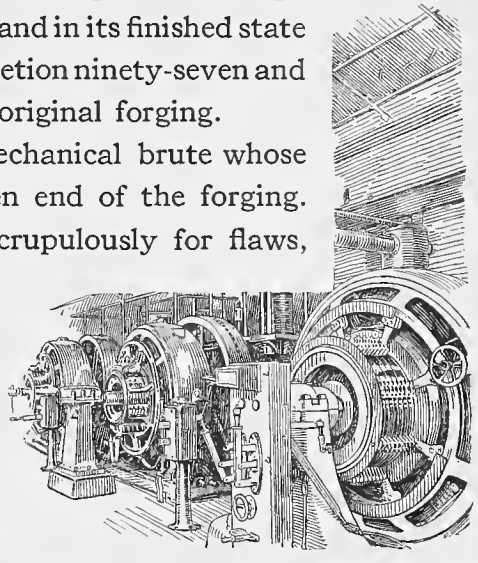
MACHINING PROJECTILES BY THE MILLION

IF THE ninety-two thousand tons of chips torn from the thunderbolts of war by the shell machines of Detroit, Depew and Berwick could speak, what a story they would tell! A story of eager, sweating workmen, stripped to the waist and hoarsely shouting in their rivalry as they rushed about. A story of flying chips and streaming, sinuous ribbons of steel curling snake-like away from steaming tools. A story scented with the odor of burning oil and echoing the flap of flying belts and the roar of rushing machinery. A story of metal being cut as metal had never been cut before.

One who has never visited a munition plant has slight conception of the multiplicity of operations and handlings encountered by a projectile in its metamorphosis from a rough forging to a finished shell. The process differs but slightly for shells of various sizes and types, and a word picture of the machining of the one hundred and fifty-five millimeter shell as it was done at Depew will give an idea of how all of the many sizes and types of projectiles were machined at the various plants of the American Car and Foundry Company.

Not only first but all the time comes the matter of transportation, for the average shell must be moved some thirty times to and from the various machines that it encounters on its journey. A one hundred and fifty-five millimeter thunderbolt, such as was machined at Depew, weighs in its rough state one hundred and seventy-three and a half pounds and in its finished state seventy-six and a quarter pounds. On its way to completion ninety-seven and a quarter pounds of toughest steel are cut from the original forging.

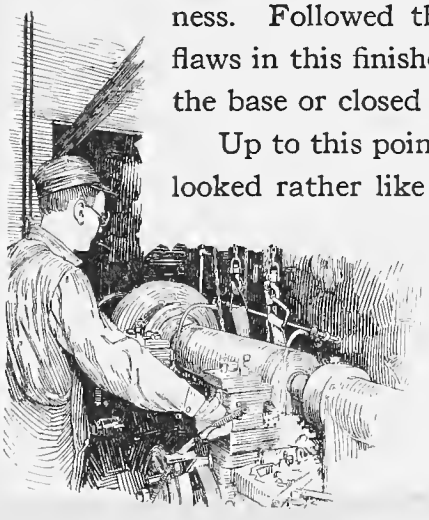
The first stop on the journey is at a burly, mechanical brute whose revolving teeth bite off the extra length at the open end of the forging. Then, after an eagle-eyed inspector has searched scrupulously for flaws,



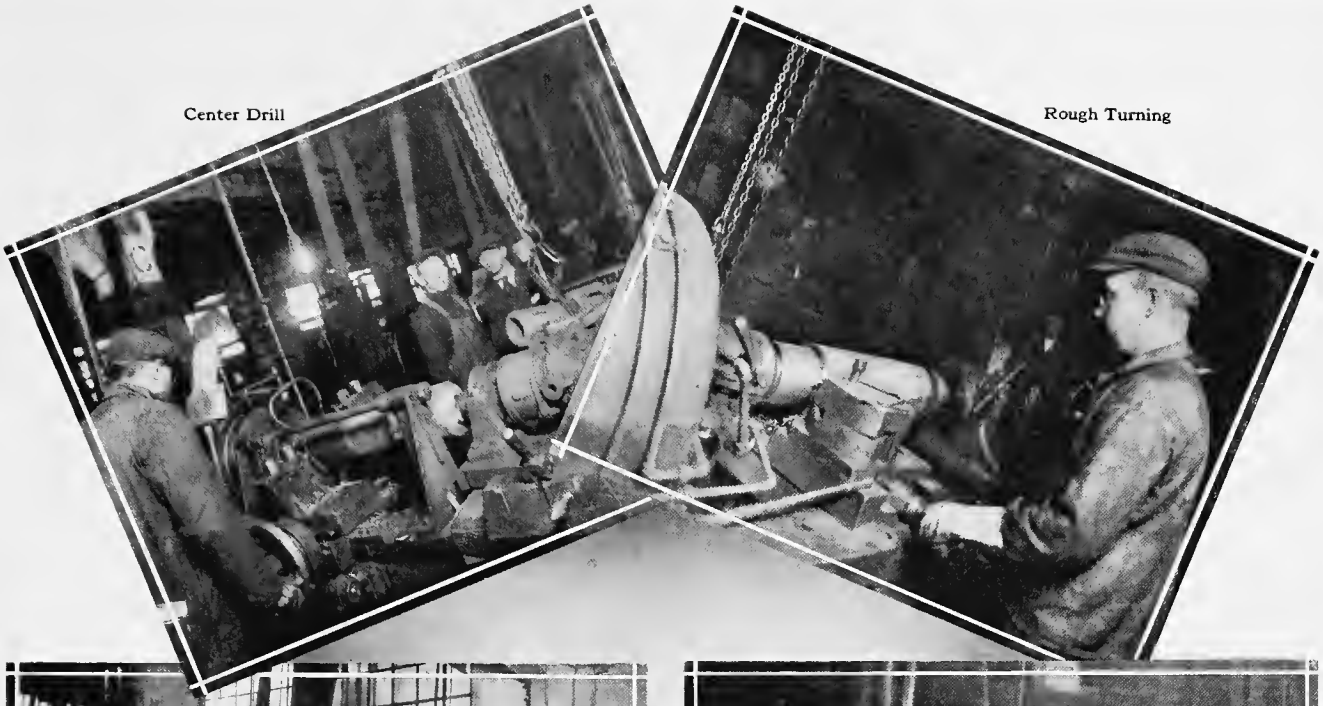
and found none, the shell is trundled to the rough turning operation. It is a "rough turning" operation indeed, for the lathe which tears away the pitted and scaly forged skin from the cylindrical surface of the shell's body, devours ninety pounds of metal in six minutes.

A digression from Depew to Detroit at this point will serve to show the pitiless punishment that ingenuity and sufficient motive power can mete out to steel. (And bear in mind that this steel that makes up the projectile is by no means the ordinary steel of commerce. For an artillery projectile must be made of steel as tough and strong as the science of the metallurgist and skill of the steel worker can produce.) When the order came to Detroit to increase its output from five hundred to a thousand ten-inch shells per day, neither shop space nor equipment was available for the rough turning operations. But these artificers of Detroit met the emergency as they had met so many others. They rebuilt the machines that they had, so that two shells could be turned simultaneously on each machine and so that two tools instead of one could cut simultaneously on each shell. They doubled the output from each machine, but mark the terrific punishment this rate of cutting involved, for at times nearly sixteen thousand pounds of turnings or chips were produced by one machine in its day's work of twenty-two hours. At certain periods the peak power loads of each of these machines ran to ninety horse-power and one pound of metal was removed per second!

But let us go back to the one hundred and fifty-five millimeter at Depew. After the rough turning of the outside of the shell came the boring of the inside, another punishing operation and one perhaps more difficult than the outside turning. In this, powerful steel jaws gripped the shell by its rough turned surface, rotating it while various cutters successively performed their surgery of steel, leaving the shell interior of finished form, size and smoothness. Followed then a visit from the eagle-eyed inspector searching for flaws in this finished interior, and next a journey to another machine when the base or closed end was trimmed, leaving the shell of an exact length.

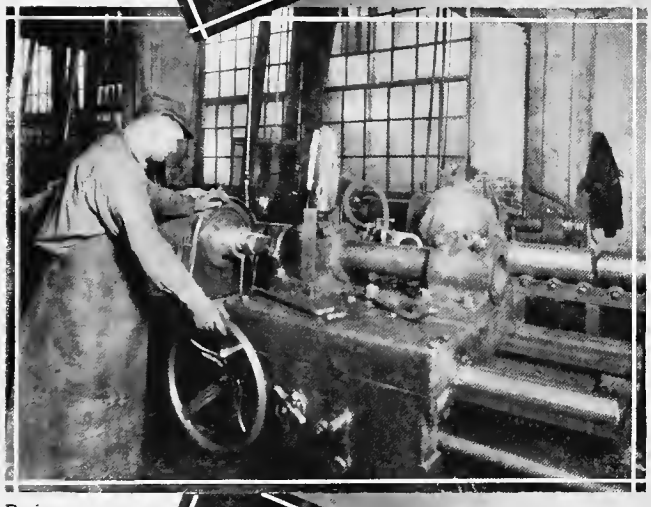


Up to this point the shell did not resemble one's idea of a projectile. It looked rather like a gigantic hollow steel rolling pin without the handles.



Center Drill

Rough Turning

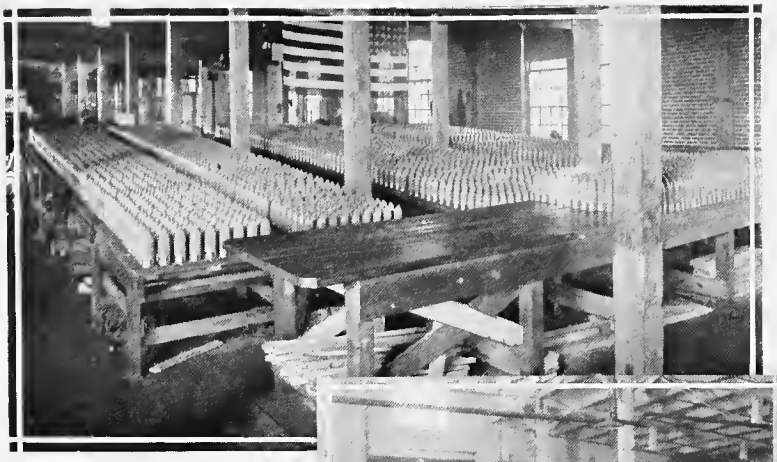


Boring

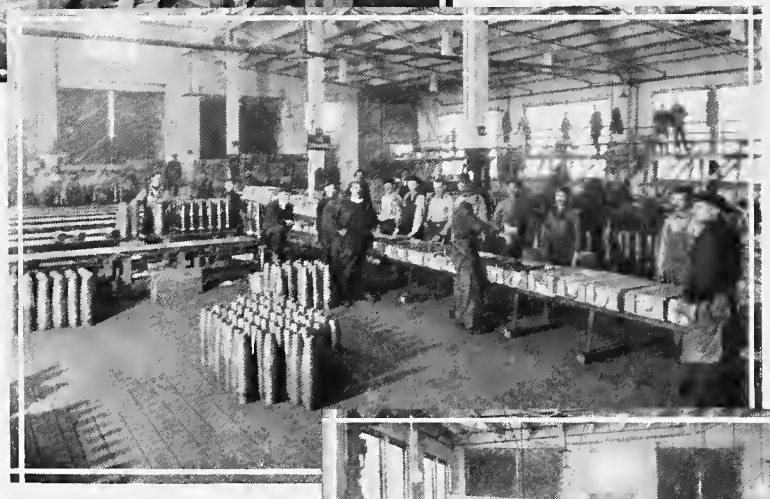
Facing
Base End

Annealing

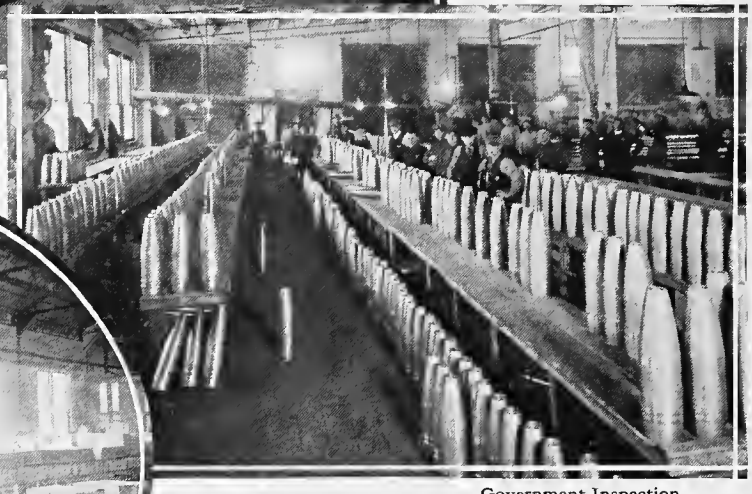
Closing Nose End



3-Inch Naval Shells
Ready for Shipment



Boxing and Shipping
155 mm. Shells

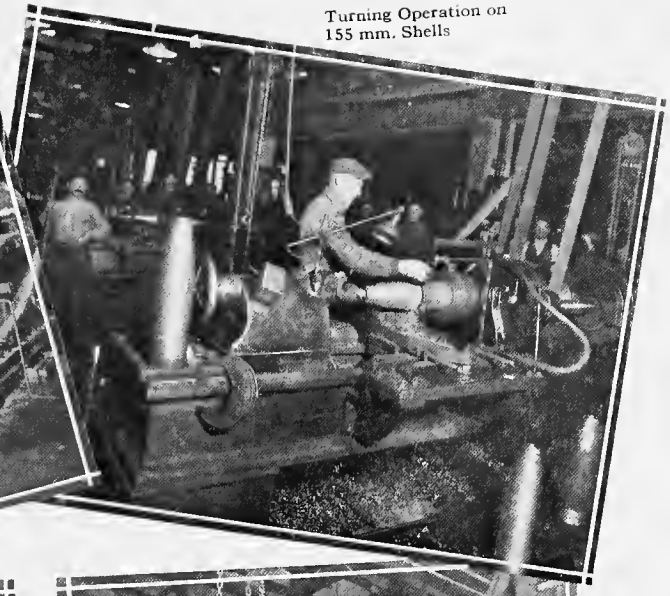


Government Inspection
of 155 mm. Shells

Corner of
Shipping Room
Berwick

Inspection of
10-Inch Shells

Nose End Operation
on 155 mm. Shells

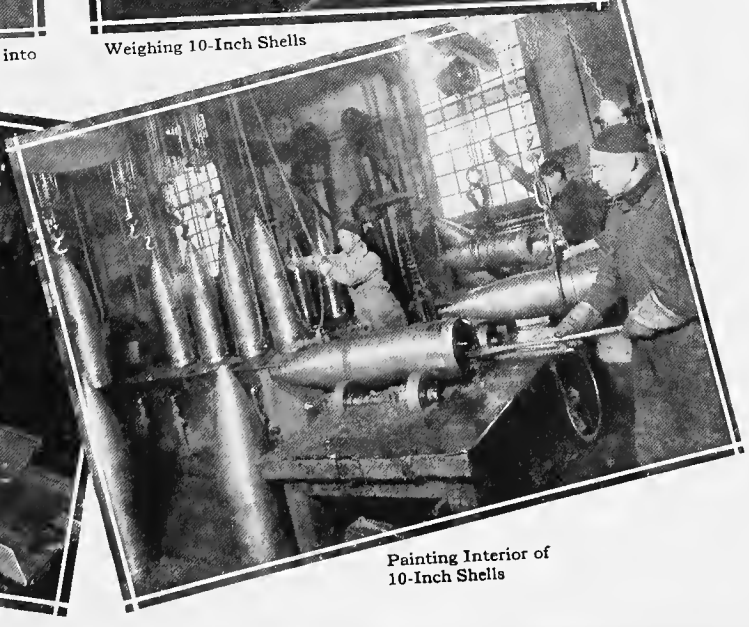


Turning Operation on
155 mm. Shells

Screwing Base Plug into
10-Inch Shells

Weighing 10-Inch Shells

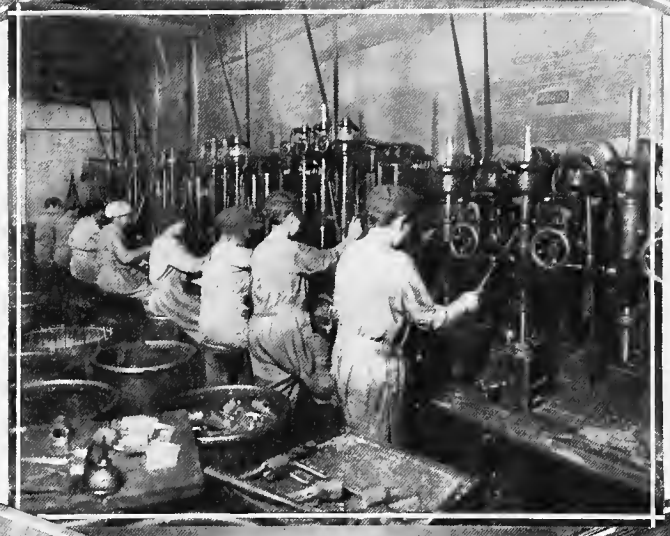
Base End Operation
on 10-Inch Shells



Painting Interior of
10-Inch Shells

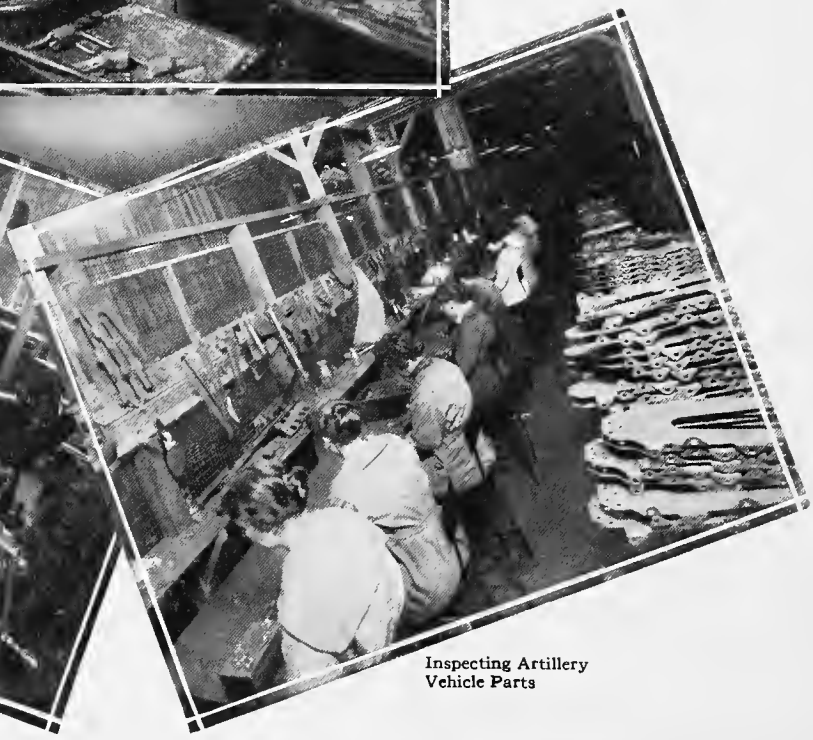
Government Inspection of
10-Inch and 240 mm. Shells

Oxy-Acetylene Welding of
Caisson Shell Tubes



Drilling
Artillery Vehicle
Parts

Machining Artillery
Vehicle Parts



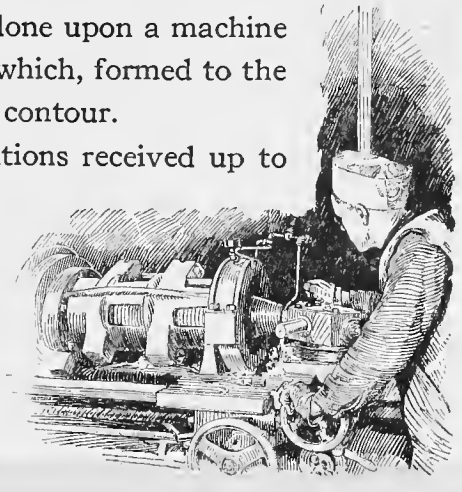
Inspecting Artillery
Vehicle Parts

For it was a straight-sided affair and lacked the curving, tapered "nose" which must be given it. For this operation fire was once more pressed into service, and the open end of the shell heated a cherry red. Into a device it went which rotated it under the blows of a hammer, the dies of which were so shaped as to give the shell its proper curving contour. Sometimes this operation was called "bottling," which very aptly described it.

Cutting and forming a shell to shape by no means completed what must be done, for the science and skill of the metallurgist was pressed into service to control the very nature of the metal. Scientists who have made a study of how alternate heating and cooling affects the molecules of steel are able to prescribe just what treatment must be given a shell to bring its metal up to the required strength, density and hardness. And this art also had to be a part of the art of a munition-making plant for each shell after it had been "bottled" was either "normalized" or "heat treated," according to its needs. Normalizing consisted of heating a shell in a furnace to the temperature of one thousand four hundred and fifty degrees and allowing it to cool normally, in air. Heat treatment consisted of heating the shell to one thousand four hundred and fifty degrees, plunging it in an oil bath to cool it, then reheating it to nine hundred and fifty degrees and then allowing it to cool normally. How these furnace temperatures can be controlled within a few degrees, how instruments, known as "pyrometers," tell what these temperatures are, and how the instruments of the physicist unfailingly tell the nature of the shell's molecular structure before and after treatment, is a story of absorbing interest, but one that cannot be told here.

Next in the journey came a machine which faced off the bottled nose of the projectile, bored it out and threaded it to receive the fuse. And after this another journey to another machine that trimmed off the surplus material left on the outside of the nose by the bottling operation. Now came the finished turning of the exterior surface, this done upon a machine in which the cutting tool was guided by a master bar, which, formed to the true shape of the shell, compelled its turning to correct contour.

One would think that with all of the varied attentions received up to

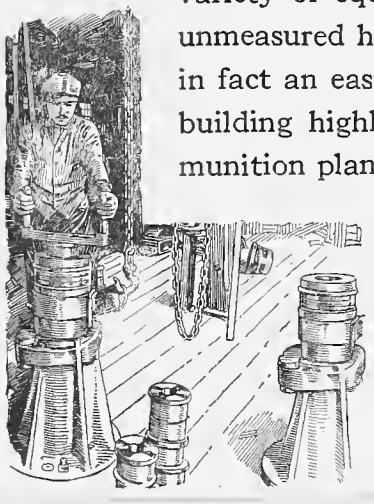


this point, the projectile must have almost reached completion. In reality it was but little more than half done. The weight of the shell is one of the most important and closely regulated points, and so next came the preliminary weighing to determine the amount of stock that had to be removed. After this weighing and an inspection was the "facing" or trimming of the base to remove sufficient steel to bring the shell to its correct weight.

Following came the tapering of the base end or as it was commonly called, the "boat tailing," for this one hundred and fifty-five millimeter shell was cigar-shaped and tapered on both ends. Then came the turning of the groove in which the copper driving band was to be seated, and the roughening of this seat to prevent the copper band from turning when the shell encountered the twist of rifling in the gun. Then came the pressing on of the copper band, red hot, and the turning of this band to its exact shape, and next the shell visited a special testing machine where, filled with air at a pressure of one hundred pounds per square inch, it was immersed in soapy water so that bubbles would reveal any porosities or cracks that the eye could not discern.

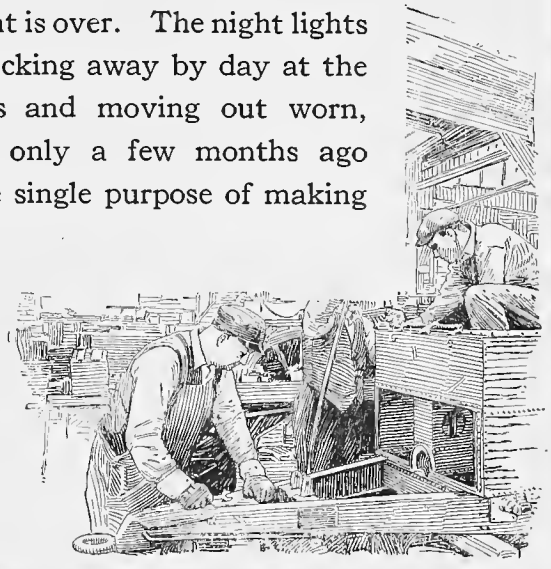
Next came the final weighing and the strict Government inspection in which all dimensions were checked to the few thousandths part of an inch. And then, the accepted shells, varnished on the outside, placed two in a box with wooden spacing pieces between them, and with wooden protecting plugs on their threaded noses, finished their journey through the plants of the American Car and Foundry Company and began their longer journey toward Berlin.

One must admit that the machining of a million shells is a complicated process and that the turning of them out at a rate of thousands per day needs not only enormous plants filled with great numbers of machines and variety of equipment, but that this task requires also the application of unmeasured human energy both in execution and direction. But this was in fact an easier task than that of securing and preparing this equipment, building highly specialized organizations and transmuting car shops into munition plants. To merely set down a list of names of the machines that



were used would give no adequate idea of the almost incredible amount of work performed in fitting up and maintaining them. These tools, as purchased from their builders, formed in the majority of cases merely the base of the machine as finally converted into a single purpose unit. An immense force of tool designers was employed to prepare the designs, and enormous toolrooms maintained to manufacture the equipment. On account of the great demand for heavy machinery, deliveries were so belated that to wait for them meant certain failure in meeting contract obligations and so to obviate this catastrophe new machines were built and old ones rebuilt to meet the emergency. Many new and ingenious methods were devised, in fact it would be hard to find one operation that did not yield to improvement over existing methods, this being particularly true of Detroit where all records were held for quantity production of the large-sized shells. Tools that cut, as did the tools at Detroit and Depew, required constant upkeep. On January 9, 1918, the toolroom force at Depew consisted of a foreman and two assistants. Within a month this force was increased to one hundred and fifty men working day and night in two shifts. Aside from preparing the tools, large forces of men were formed into emergency repair gangs whose function was to rush at a moment's notice to a disabled machine and get it quickly into action. Networks of pipes for carrying cutting lubricant to and from the many operations were laid in improvised machine shops, from which old piping, platforms, air connections, railroad tracks and ties were taken away. Departments were created for acetylene welding, hardening and tempering of tools, and provisions made for electricians, millwrights and tinsmiths, while, in the meantime, inspection methods and means of instructing new workers had to be developed.

And now the rush and confusion and excitement is over. The night lights are out, and a handful of wreckers are busily pecking away by day at the business of tearing down temporary structures and moving out worn, war-wrecked machines from the shops where only a few months ago thousands of men toiled day and night with the single purpose of making shells and still more shells.



THE CHARIOTS OF MARS

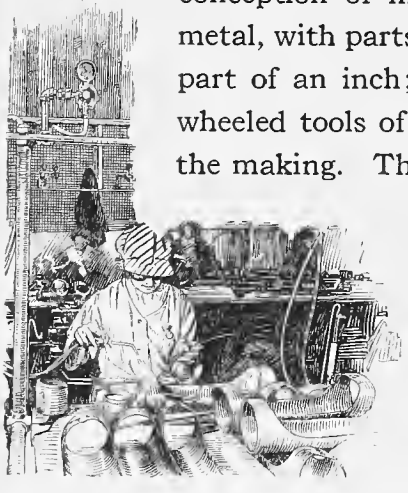
NO war service undertaken by this Company portrays a more astounding picture of responsibility and accomplishment than does Detroit's production of artillery vehicles. To sense the immensity of it you must start with the knowledge that in more than the half century between the Civil War and 1917, the arsenals of our Government had produced less than a thousand artillery vehicles. No single year had seen the making of more than three hundred.

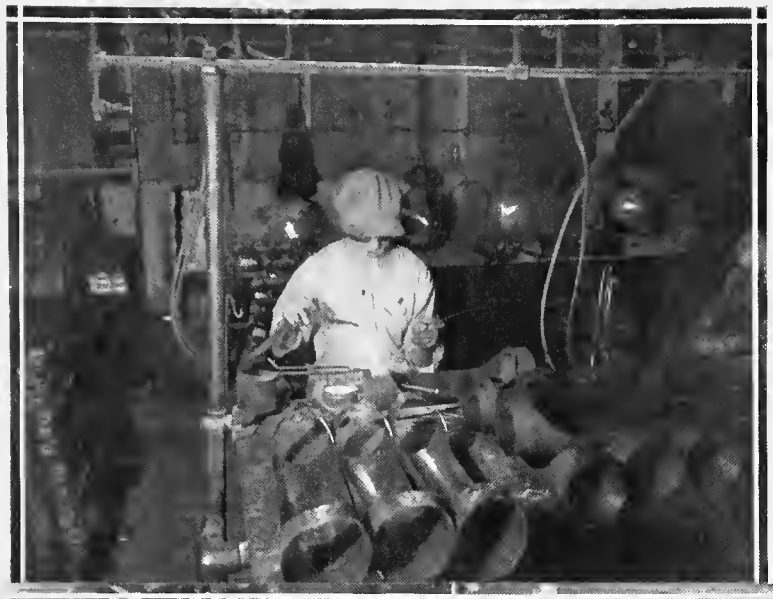
And then, in April, 1917, came America's call to war and with it her cry for arms.

Shells and guns for our fighters could be had from our Allies, at least until the munition shops of America swung into action. But for the chariots of Mars—the limbers, caissons, battery wagons and store wagons that rumble into action with the artillery—for these America was thrown entirely upon her own resources. And at that time, June, 1917, America's sole dependency, obligated to produce ten thousand nine hundred and seventy of these vehicles at the rate of one hundred per day, was the American Car and Foundry Company. Upon the ability of this Company to fulfill its obligations, actually rested the whole war programme of the United States Government.

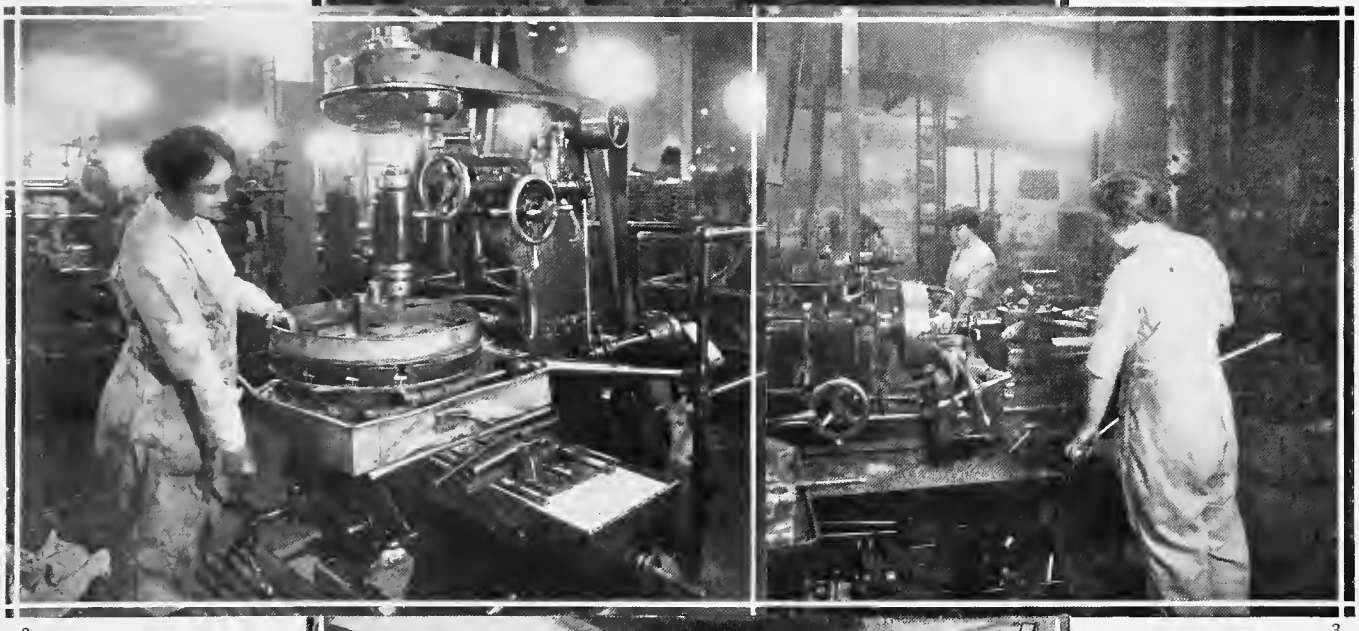
What a tremendous responsibility! Let the forty-seven thousand eight hundred and twenty-five vehicles produced by Detroit during the ensuing nineteen months tell how that responsibility was met!

The name "artillery vehicle" is deceptive. These caissons, caisson limbers, battery wagons, forge limbers and store wagons, conform to one's conception of machines, rather than vehicles. Made almost entirely of metal, with parts interchangeable; workmanship accurate to the thousandth part of an inch; built for battle and armored against attack, these two-wheeled tools of Mars are super-vehicles indeed, both in the being and in the making. Their giant axles, weighing in the rough from three hundred





1



2

3

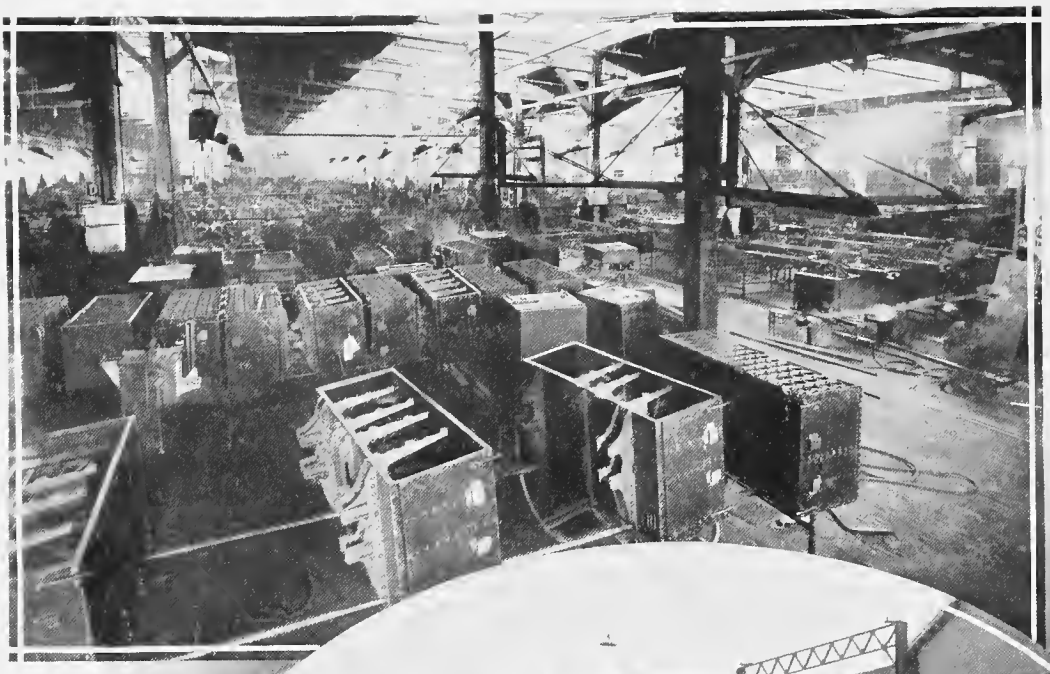
4

1 Welding Shell Tubes Together by Means of Oxy - Acetylene Gas for Artillery Vehicles

2 Machining Artillery Vehicle Steel Parts

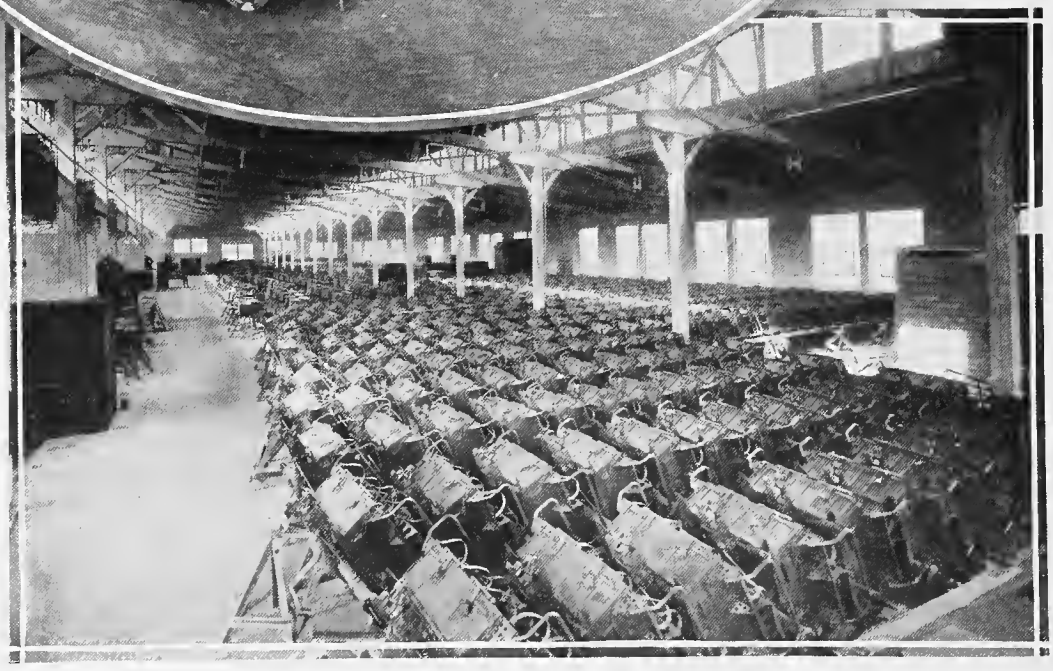
3 Machining Artillery Vehicle Brass Parts

4 Camouflaging Artillery Vehicles in Paint Shop



Assembling of
Artillery Vehicles

Storage of
Artillery Vehicles—
Ready to Ship

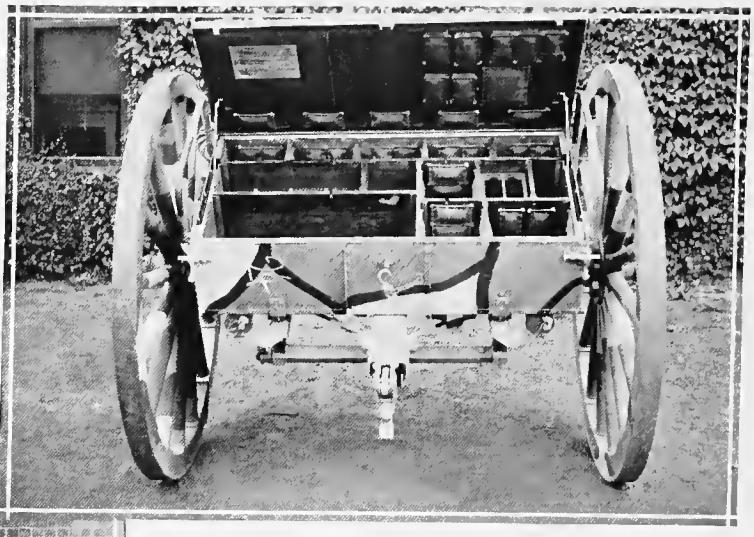


Artillery Vehicles in
Paint Shop—
Painted and Drying

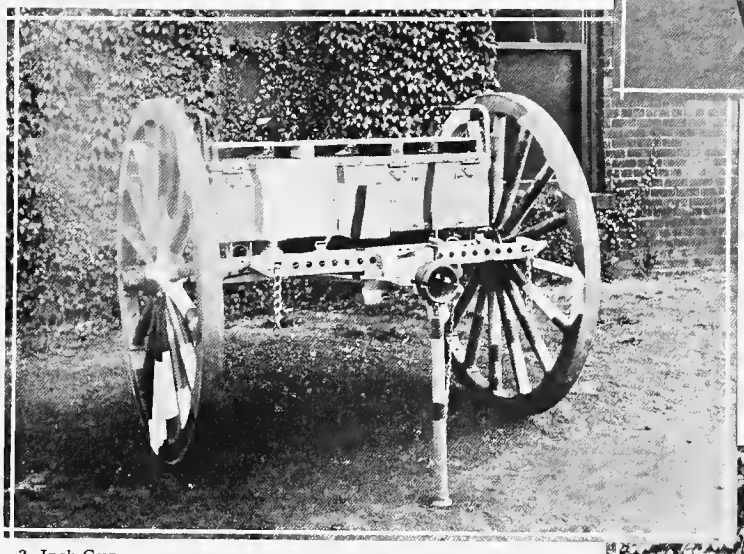
Final Assembly
of Artillery Vehicles

Artillery Vehicles
Stored Awaiting
Instructions
to Ship

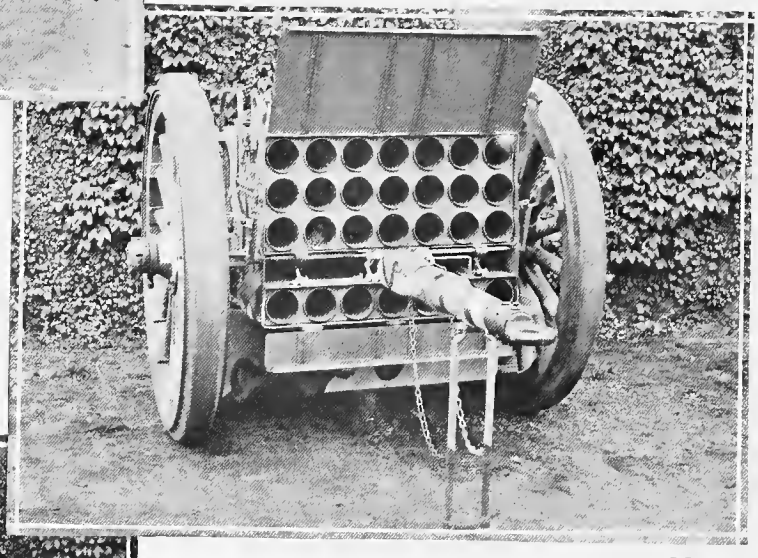
Shipping Artillery Vehicles
to U. S. Government
Testing Grounds



3-Inch Gun
Store Limber

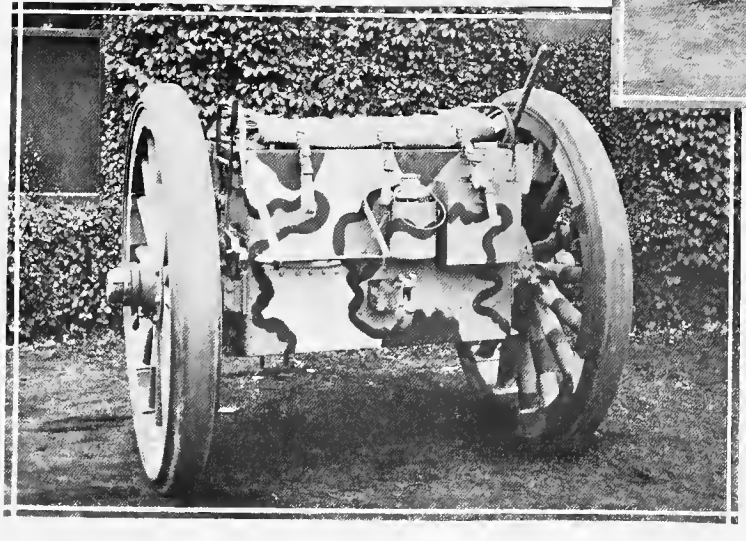


3-Inch Gun
Forge Limber



4.7-Inch
Gun Caisson

4.7-Inch Gun Caisson,
Rear View



and ninety to five hundred and fifty-four pounds, were bored like guns and with their tapered bearings turned to mirror smoothness, called for six forging and thirty-eight separate machining operations. Millions of pounds of brass and steel and iron were wrought and shaped and cut; ninety-four different varieties of material were fabricated, to carry out the Olympic task that followed the fiat, "Let there be chariots of Mars!"

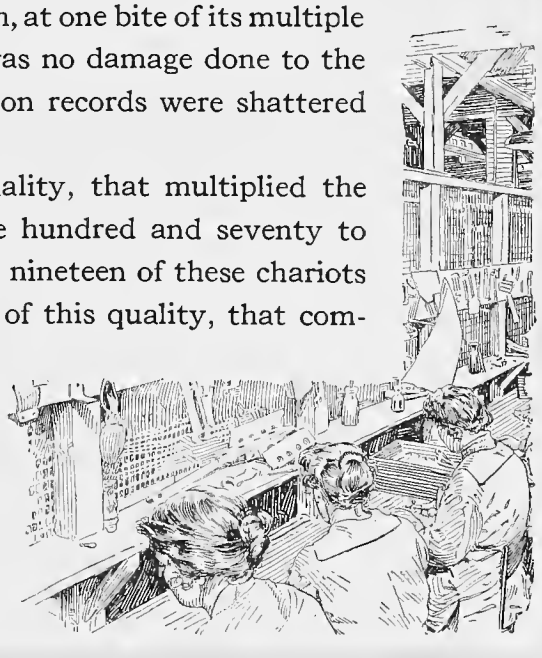
The task was accomplished. The detailed story of its accomplishment would fill a volume. It is made up of a mosaic of ingenuity and persistency, of which the following is typical:

The caisson, which takes its battle position beside the gun, is designed to protect the gun crew as well as to carry ammunition. To this end its ammunition chest door, back and apron were made of armor plate. This steel was tough and hard enough to resist a rifle bullet at short range, and yet holes had to be drilled in each plate (and there were one hundred and ten acres of these plates) to receive the hinges and latches.

The caissons could be built no faster than armor plates for them were drilled, and the tough, bullet-resisting steel forbid fast drilling. And so came the necessity of finding better and quicker ways to pierce these plates.

A special drill, made from a new alloy of metals, did not solve the problem, although it improved production. But the shops still cried, "plates, more plates." And then came the inspiration, an inspiration commandeered by persistence and the genius of hard work. Needle-pointed flames of oxy-acetylene, gas, arranged in batteries to correspond with the location of the holes softened the plate at the immediate points for piercing. A moving table carried each one quickly to the jaws of a press which, at one bite of its multiple teeth, punched every hole in the plate. There was no damage done to the bullet-resisting quality of the steel, but production records were shattered beyond recognition.

It was work of this kind, ability of this quality, that multiplied the original Government order of ten thousand nine hundred and seventy to a total of fifty-three thousand three hundred and nineteen of these chariots of Mars. And it was work of this kind, ability of this quality, that com-

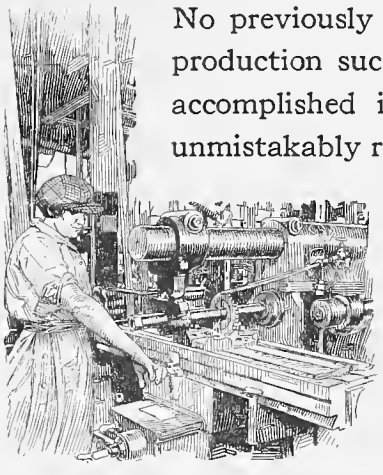


pleted ninety per cent. of this enormous total before the unexpectedly early termination of war and war contracts.

No resident of Detroit or visitor to that city, who saw it, will ever forget the great park of artillery that built up when the three-hundred-vehicle per day production rate outran the ability of the railroads to carry them away. 8,000 caissons, limbers and wagons were stored in and around the plant. No such vast panorama of war vehicles has ever before been seen in America.

It is sometimes said of peace-time industry that the hardest work must come before the first finished article can be produced. And in war time this is doubly true. No one save those who were a part of it will ever realize the sleepless activity, the incessant toil, and enormous mental and physical expenditures that paid for the first "chariot of Mars." Before it came, had to come not only the designing, but also the making of thousands of cutting tools; not only the designing, but also the making of thousands of jigs, fixtures and templets to secure interchangeability; not only the purchase and installation of hundreds of machines, with their foundations, shafting, motors, wiring and piping, but also the construction of new buildings to house them. Store houses, toolrooms and warehouses were built, in addition to production buildings. Four goodly structures sprang into being just to house the activities of boxing and packing. Four hundred inspectors were organized and trained, independently of the Government's inspection force, to insure accuracy and quality of workmanship. For the clerical force and plant executives, thirty thousand square feet of floor space were required. These items are spotlights that illuminate portions of the task and give some vision of its immensity.

If these forty-seven thousand eight hundred and seventy-five chariots of Mars had been the American Car and Foundry Company's sole contribution to America's war effort, it would still have been a worthy accomplishment. No previously established policy of manufacturing would have permitted production such as this, nor would mere machinery or organization have accomplished it. The magic talisman of thorough co-operation stands unmistakably revealed in the making of these chariots of Mars.



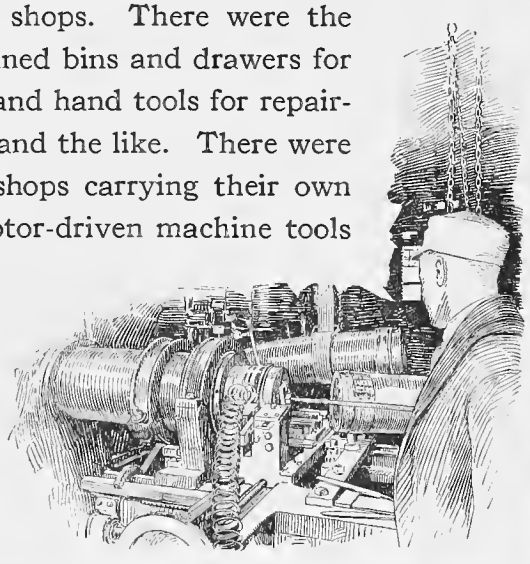
FIRST AID TO THE ARTILLERY

MODERN war places a heavy burden upon artillery. Long range and quick-firing are requisites, but not sufficient, for guns must move with the mobility of men. Cannon must consolidate the gains made by the infantry and when the latter takes an advanced position, artillery, if this advance is to be held, must quickly follow up the infantry. Thus came the motorization of artillery, one of the greatest engineering developments of the World War.

The motorization of artillery means also the motorization of machine shops. First aid to injured guns is in warfare as necessary as first aid to wounded soldiers. Just as hospitals were put on wheels and took their positions near the front line trenches, so wheeled machine shops brought machine tools to injured guns and kept them on the firing line. Thus in attacking the enemy, the three branches, infantry, artillery and the service of supply with its portable machine shops, moved forward in parallel waves; not as in former wars when infantry, alone defending captured territory, looked despairingly for the laborious coming of the guns days afterward.

And so the battlefield became a gigantic machine shop where mechanics fought against time, while fighters battled against the Hun. Portable shops of every description, mounted upon motor truck chassis, darted about rendering service first to a disabled "seventy-five," next to a troop lorry and again stopping to administer to a shell-shocked Caterpillar tractor.

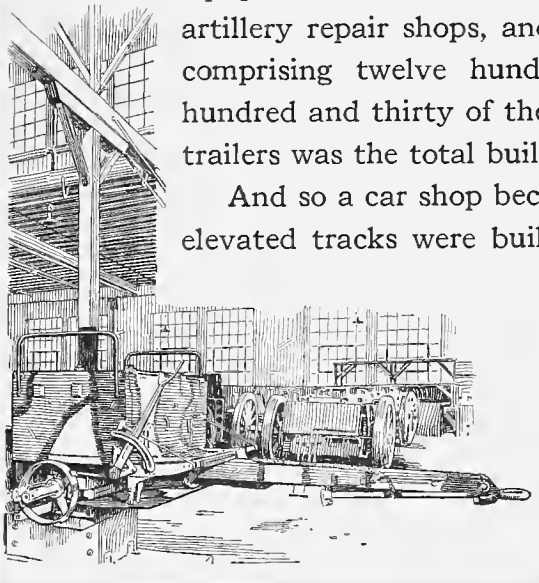
Many were the varieties of these motorized shops. There were the equipment repair trucks whose steel bodies contained bins and drawers for parts and materials and carried sewing machines and hand tools for repairing personal equipment, small arms, leather belts and the like. There were the artillery repair trucks; automobile machine shops carrying their own power plants for the generation of electricity, motor-driven machine tools



such as lathes, drilling machines and grinders. There were the self-propelled blacksmith shops, mounting forges, blacksmith's anvils and drilling machines. There were the portable sawmills with their motor-driven buzz-saws for quickly, if need be, ripping trees into timbers. There were the welding shops with their steel cylinders of acetylene and oxygen, and the torches equally ready to cut the steel beams of a bridge or to weld a cracked water jacket. There, too, were light repair trucks, containing the smaller tools such as were used by carpenters, automobile mechanics and machinists, carrying tools and the men who used them wherever they were needed. On some of these trucks there were as many as seven hundred different items of equipment.

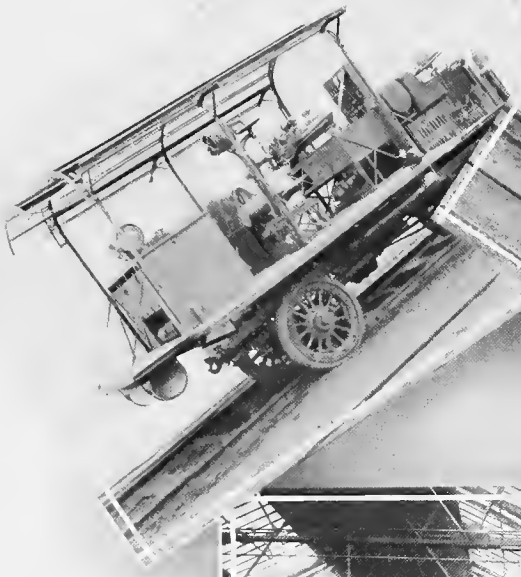
Most interesting of all, perhaps, and the latest development of motorized mechanical service were the "motor train units." Thirteen mobile repair trucks and twelve four-ton trailers comprised each unit, together constituting a complete machine shop with its power plant and all mechanical departments, ready when parked at its destination to perform any service within the ability of an ordinary machine shop. For here within the unit was contained not only metal cutting tools of every description, but also air compressors and pneumatic tools, a complete toolroom for the making of auxiliary tools and equipment, a woodworking shop, a stockroom with spare parts for motors and for guns, trucks fitted for the personal baggage of the shop workmen, and other trucks for carrying gasoline and oil to feed the power plant.

And now we come to Berwick's share in this first aid to artillery. It consisted in building for Uncle Sam's service two hundred and ninety-eight equipment trucks, one thousand three hundred and thirty-two portable artillery repair shops, and forty-eight of the motor train units, the latter comprising twelve hundred individual vehicles. Two thousand eight hundred and thirty of these moving machine shops, equipment trucks and trailers was the total built by Berwick.

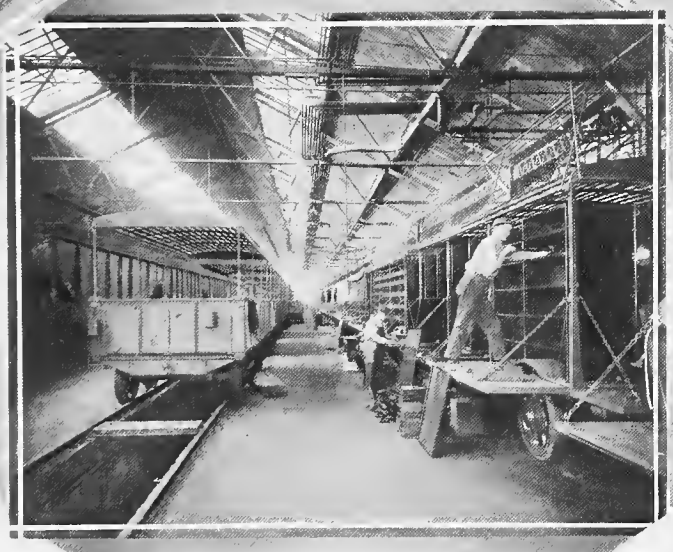


And so a car shop became transformed into an automobile plant. Two elevated tracks were built of sections fourteen feet long, five feet eleven

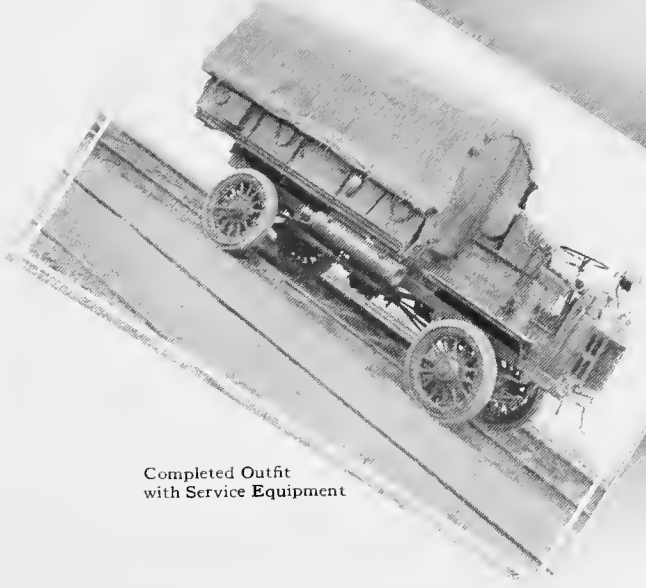
Machine Shop in Operative Position—Tarpaulin Removed



Machine Shop in Running Position—Tarpaulin Removed

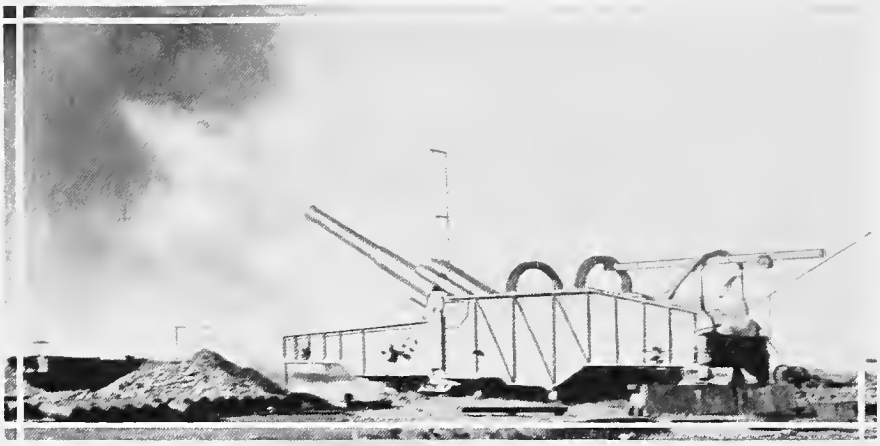


Assembling Repair and Equipment Bodies



Completed Outfit with Service Equipment

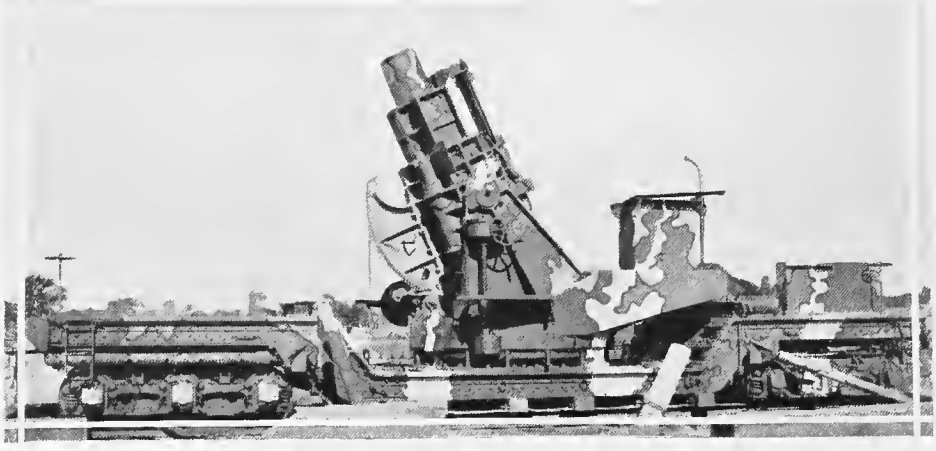
Completed Equipment En Route to Port for Shipment Abroad



Firing 14-Inch Gun
on Railway Mount,
Model E

Firing 12-Inch Mortar,
Railway Mount,
Model 1918 MI

Firing 8-Inch Gun, Railway Mount, Model 1918 MI

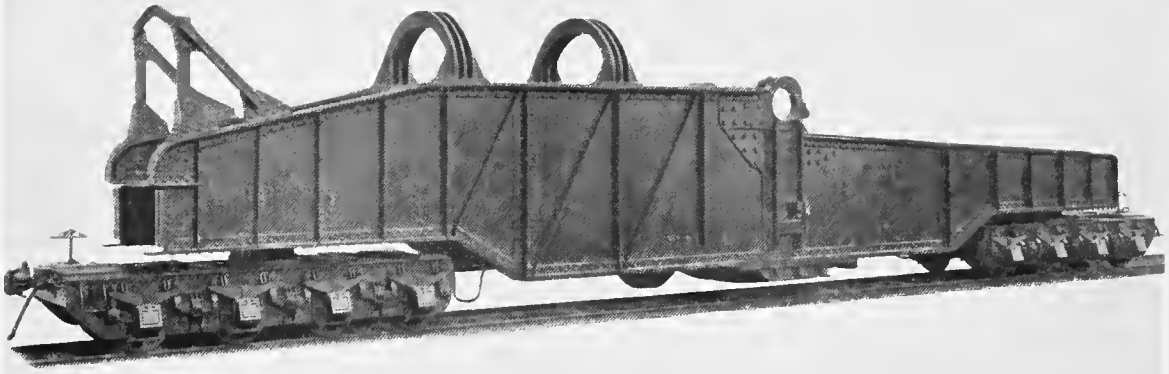


12-Inch Mortar,
Railway Mount

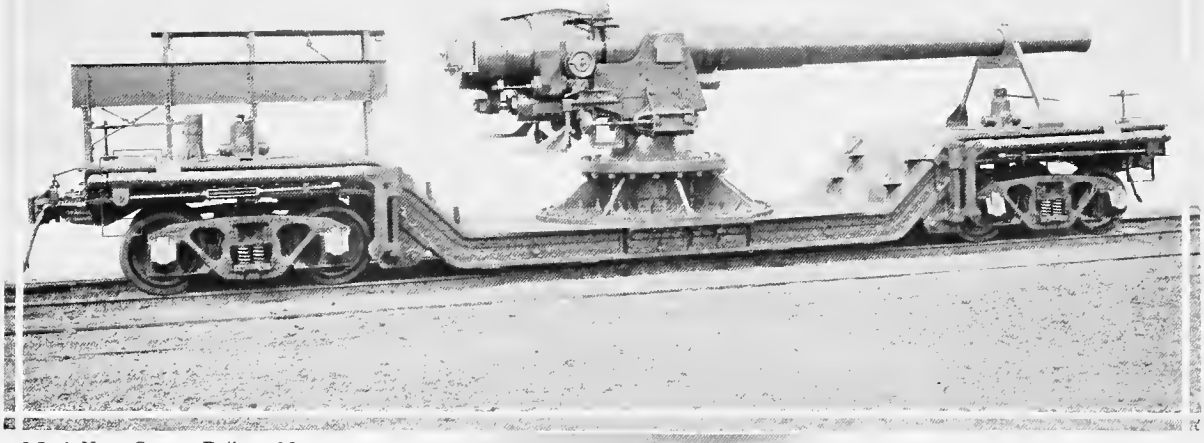
14-Inch Gun on Railway Mount, Model E, for Seacoast Defense

8-Inch Gun on Railway Car, Model 1918 MI, in Firing Position; Ammunition Car Coupled in Rear

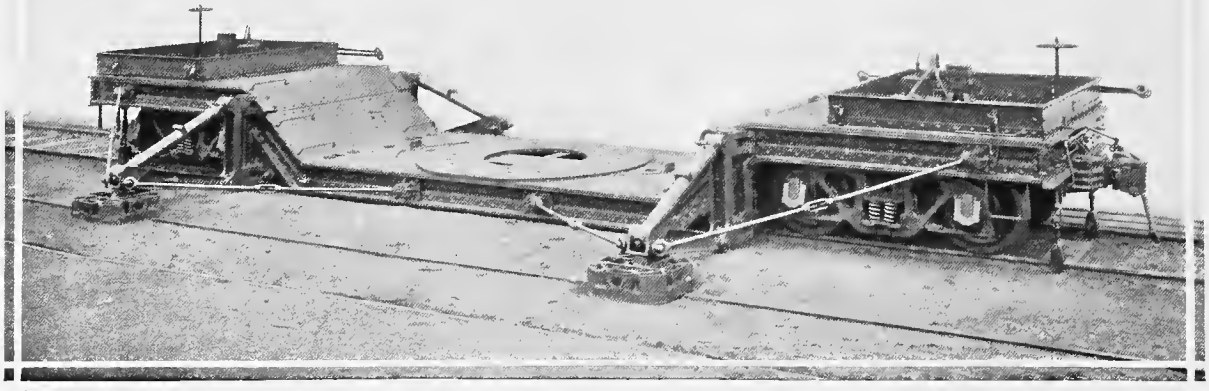
7-Inch, 45-Calibre Navy Gun, Barbette Carriage, Mounted on Railway Car, Model 1918 MI



Railway Mount, Model E,
for 14-Inch Gun



7-Inch Navy Gun on Railway Mount,
Model 1918 MI

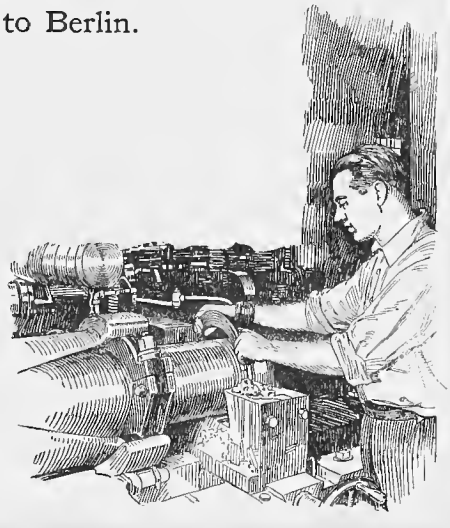


Railway Mount, Model 1918 MI,
for 8-Inch Gun

inches wide and two feet six and a half inches high. Each track, composed of twenty-four sections, extended for a length of three hundred and thirty-six feet. On these tracks occurred the "progressive assembly" of the portable machine shops, which is to say, that at one end they started as a mere nothing and at the other end rolled off complete and ready to run. Seven days was the time required for the completion of a full-fledged artillery repair shop. Each day each truck proceeded further down the track toward the end of its journey followed continuously by other trucks in less advanced stages, while busy workmen swarmed about adding individually their designated bits to the completion of the work.

First came the making of the underframe, the riveting of the bars of steel which was to form the foundation. Next this underframe was picked up by an overhead hoist and placed upon wheels which carried it down the tracks to the successive operations until the body was completed. At the lower end of each track the completed body was raised by another hoist and placed upon its chassis ready for the installation of machinery, the various cabinets having been built in on its journey down the track. This was the routine for seven bodies a day on each track on an eight-hour shift. Four days after starting down the track a body was finished, all cabinets having been installed and the body painted. On the fifth day it was mounted upon the chassis and the machinery was put in motion. On the sixth day the small tools were put in, the large tools thoroughly tested and the canvas cover put on. On the seventh day the truck was given its road try-out.

To those privileged to observe the seven-day period of creation of a motorized machine shop, it was an inspiring sight to see what but a week before had been steel bars, rivets, motor truck chassis and piled-up equipment rapidly crystallize into a complete moving machine shop ready to start on its journey to carry Berwick's war challenge to Berlin.

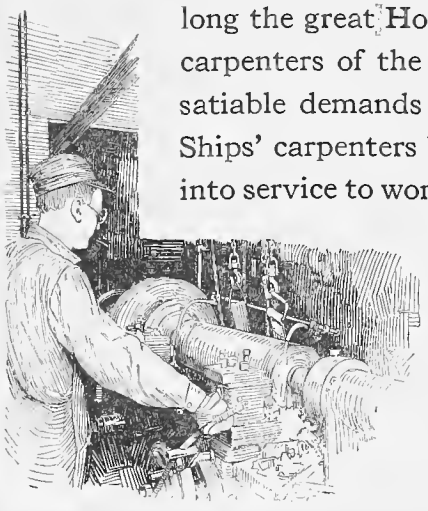


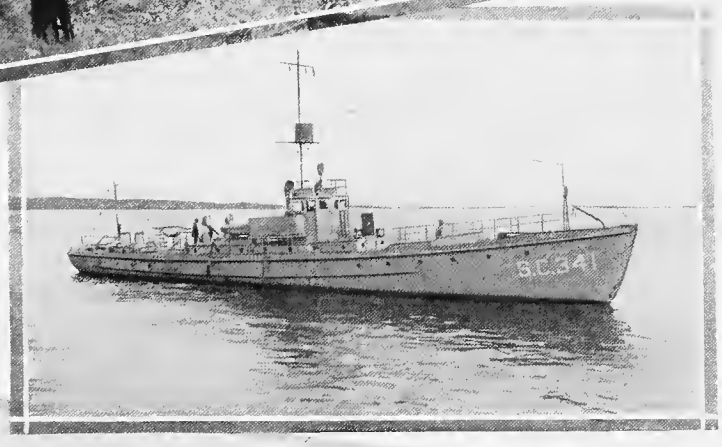
SEA SCOURERS TO SCOUT FOR SUBMARINES

THE tap, tap, tap of the caulking chisel upon the sides of wooden ships kept time in the shipyards of America, during the World War, with the staccato beat of the riveting hammer. For ships of wood had war duty to perform as well as did giant steel cargo carriers. And so as the great war panorama of 1917 unfolds, we see the car builders at the Wilmington plant of the American Car and Foundry Company, transformed by the magic wand of patriotism into ship carpenters, building submarine chasers for Uncle Sam.

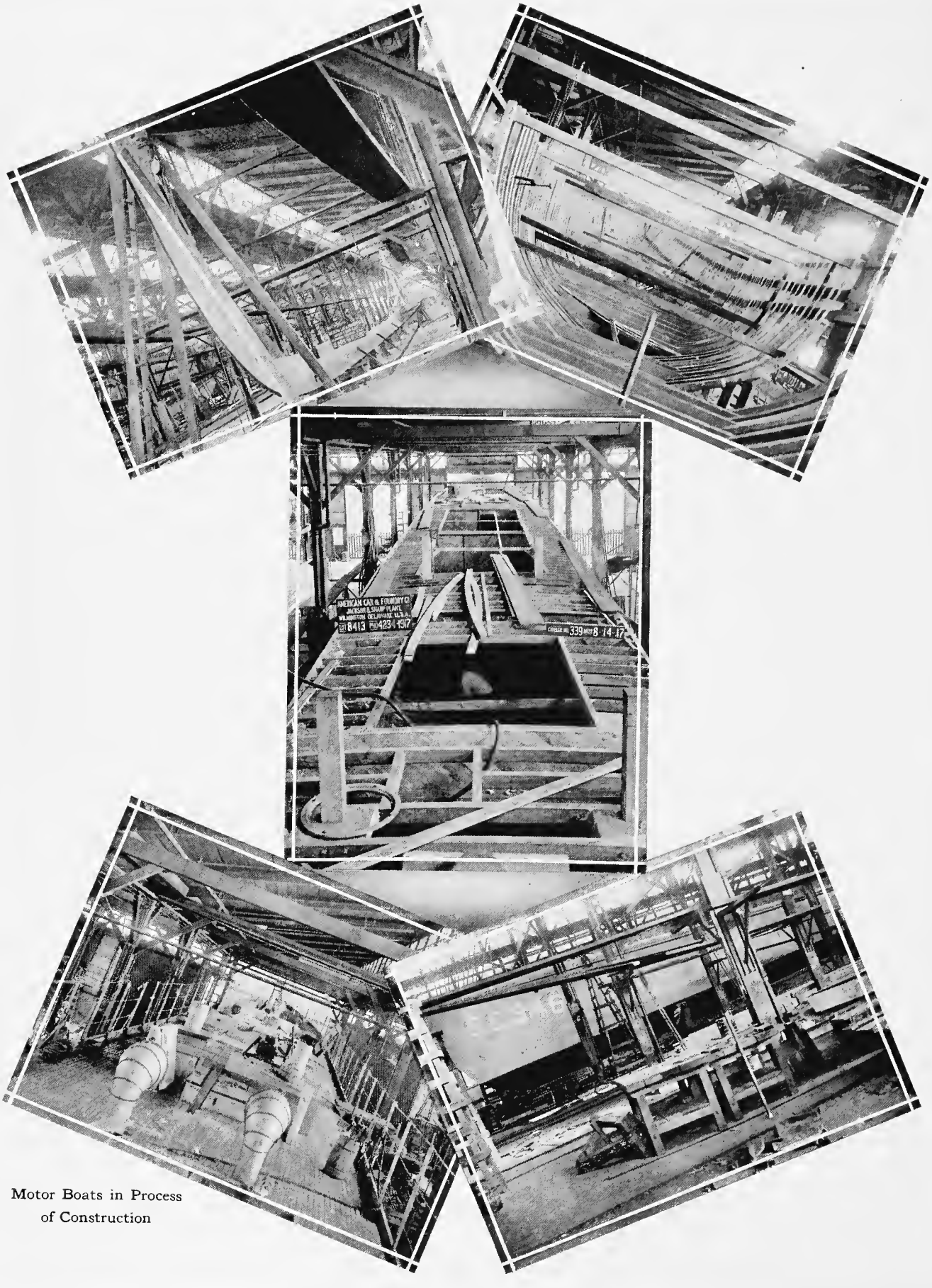
And a submarine chaser was not an easy thing to build even under the best of circumstances. Its duty of scouring the seas for submarines called not only for speed but staunchness. Scanted joints or slipshod finish would not suffice for sea worthiness in these ocean scouts of ours whose duty it was to convey Uncle Sam's greetings to the Kaiser's submarines. Long, slender and rakish with knife-like prows, and slender, wireless antennae, salt water bloodhounds, the building of these sea scouts meant death to Von Tirpitz's crews—a death sentence pronounced and executed at the same instant and with the same instrument—the deadly depth bomb.

Wilmington was not without experience in building wooden ships. It has a shipbuilding plant that has been in active operation since 1860. And in 1914 and 1915 it launched the largest gross tonnage of wooden boats put out by any American shipyard in those two years. But nearby were the Cramps Shipyards and others bordering on the Delaware, and before long the great Hog Island Shipyard came into existence. The skilled ships' carpenters of the Wilmington plant began to disappear, drawn by the insatiable demands of these plants that were building wooden cargo vessels. Ships' carpenters became scarce indeed and so carbuilders had to be pressed into service to work upon the eight submarine chasers ordered from Wilming-





Triple Screw Motor Boats for service by U. S. Navy Department as Submarine Chasers. Several of these boats proceeded overseas under their own power



Motor Boats in Process
of Construction

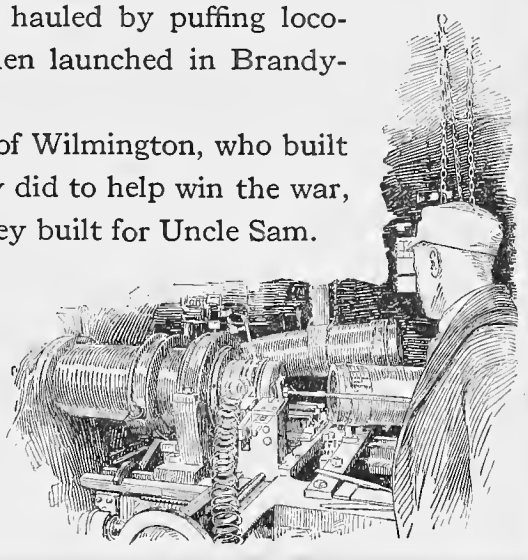
ton by our Government on April 30, 1917. The building of these sea scouts was not by any means all that the ship-builders at the Wilmington plant were called upon to do in the way of war duty. For, in the busy Delaware, teeming with unusual activity, collisions and minor accidents were of frequent occurrence. Many damaged boats were taken to the shipyard of the American Car and Foundry Company at Wilmington where emergency repairs were made for Uncle Sam. Thus, the work of building submarine chasers was interspersed with other vitally important war service.

The contract specified that two boats should be delivered within a period of seven months and that the six additional chasers should be ready not later than January 1, 1918. This meant that a total of eight months was allowed for the building of the eight boats. Six months from the date of contract, in spite of the additional repair work that has been mentioned before, the eight boats were launched.

Throughout all of this time one hundred men busily hammered and sawed, fitted and caulked, watched each day's growth of their maritime progeny, and worked with the enthusiasm of men who knew that each hammer blow was a blow for freedom and democracy.

And so eight of these scourers of the sea were built for Uncle Sam in a car shop and largely by car builders. For the shipyard was not used for this work but kept open to care for the repairs so vitally important to the cause. The car shop, as shown in the illustrations, became transformed into a veritable indoor shipbuilding plant in which the few ships' carpenters that could be obtained multiplied their skill through the hands of many car builders. The first journey of these sea scourers after completion was an overland journey. Mounted on trucks they were hauled by puffing locomotives for a distance of over half a mile and then launched in Brandywine Creek.

In the coming years, when these car builders of Wilmington, who built ships when ships were needed, are asked what they did to help win the war, they will tell with pride of the sea scourers that they built for Uncle Sam.



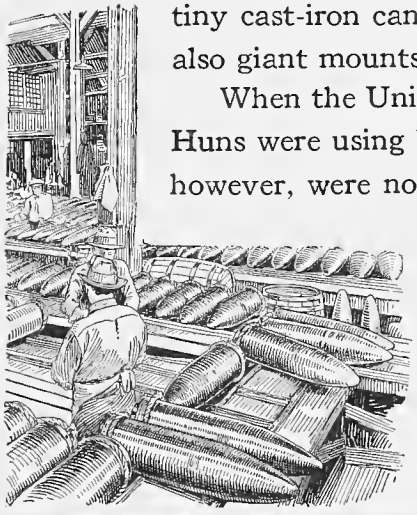
MONSTER MOUNTS FOR RAILWAY GUNS

IN former wars, the range of a big gun measured its potency. But in the World War from which we have just victoriously emerged, the potency of a big gun was measured by the distance between where it was on Monday and where it could place a shot on Tuesday. The range of a modern big gun is not merely the number of miles that it can shoot, but is its firing range plus its range of mobility.

And thus came railway artillery which made the fort a portable institution.

These giant railway mounts were the last touch that modern engineering skill gave to modern artillery. Eight, ten, twelve, fourteen and even sixteen inch monsters accompanied by their ammunition cars, their supply cars, their fire control cars, and their spare parts cars, crept silently through the night to strategic positions, where they transformed defenceless terrain into a veritable Metz or gun-bristling Mons. Wherever tracks could be laid these monster guns would go, playing tag with the enemy's heavy artillery, firing their shots and then taking new positions so that the counter-fire could not find them. Thirty minutes after one of these Leviathans had belched forth its charge of destruction and shaken the earth with the reverberation of its thunder, gun and cars would be hurrying away before the enemy could obtain their range.

It is in keeping with war's diverse demands on American industry that the American Car and Foundry Company, which furnished Uncle Sam with tiny cast-iron candlesticks for tent lights should be called upon to provide also giant mounts for railway guns.



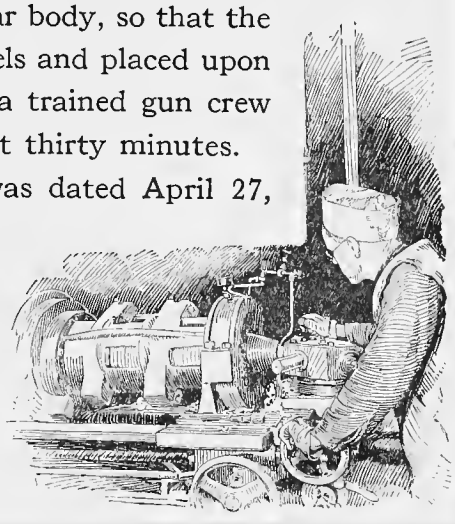
When the United States entered the World War both the Allies and the Huns were using heavy artillery mounted on railway cars. These mounts, however, were not at all like the ones that are pictured in this book. All

of them were limited in range except for a slight angular variation to the general direction of the track. In other words, if you desired to aim one of these guns at a certain object it was necessary to lay the track so that the entire car would point in this direction. You could not fire these guns crosswise of the car without building up extensive braces and foundations to take the recoil and to prevent the kick-back throwing the car from the track. If you built these extensive foundations it meant losing mobility; if you did not build them it meant sacrificing flexibility of range.

To overcome these hardships our Army Ordnance Department designed the railway gun mount known as the Model of 1918-MI. This mount was used with the eight-inch Army rifle, the twelve-inch seacoast type mortar and the seven-inch Naval rifle; monsters which weighed with their mounts complete, from one hundred and sixty thousand to one hundred and eighty thousand pounds. In one of these mounts the gun could be swung entirely around a horizontal circle, aimed and fired at any point of the compass without moving car or tracks.

The mounts themselves represented the ultimate in steel railroad car construction. Built not only to carry enormous weight but also to resist the almost unmeasurable shock of firing, they involved, in addition to strength, mechanisms of wonderful ingenuity and efficiency. One man could with ease swing the heavy gun either horizontally or up or down, handling it as easily as one would handle a seventy-five millimeter field piece. In design this mount was undoubtedly the most advanced type of heavy artillery railway mount. To provide stability and to care for the enormous recoil shock, steel arms were pivoted to the car body. These swung in close and clamped to the car when not in action but swung out from it and were braced against the kick-back of the gun when the latter was fired. Jacks were provided as an integral part of the car body, so that the weight of trucks and gun could be taken from the wheels and placed upon the track. Yet with all of this apparent complexity, a trained gun crew could place the piece in action or withdraw it in about thirty minutes.

The initial contract was for twelve mounts and was dated April 27,

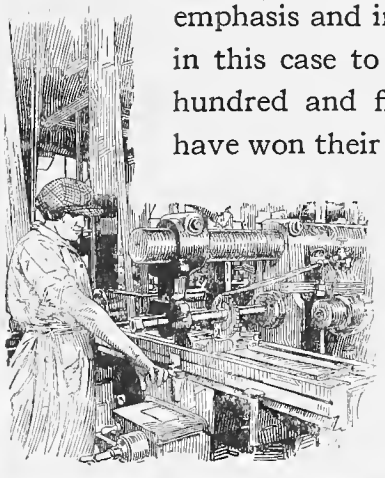


1917. Detailed drawings, requisitions and orders for materials, dies for forming parts, templets and tools, in fact all of the many details needed for a new design had to be provided and materials obtained at a time when busy manufacturers were working to capacity on other Government work. The Car Company's obligations required delivery of a sample mount by August 13th. Work in the shops started early in May, and hardly had it begun when urgent requests to make delivery came pouring in. When one considers what an enormous task it was to build not only such a giant monster under such adverse conditions, but also to assume responsibility for producing the first one in less than four months, it is a remarkable tribute to the energy and ability of the officials and workmen of Berwick that the promised delivery date was anticipated by fully fifty days. For on June 23, 1917, nearly two months before it had been promised, the first American eight-inch railway mount rolled out of Berwick on its way to the proving grounds.

Altogether seventy-seven of these monsters, Model 1918-MI, were built for Uncle Sam. One should bear in mind that each unit of railway artillery required the building of an armored train of ammunition cars, spare part cars, supply cars, and fire control cars, the latter having as complete a range finding and testing equipment as any of our permanent coast fortifications.

And there was built at Berwick, in addition to this fleet of mobile guns, the giant Model E mount for the great fourteen-inch Army rifle which fires its twelve hundred pound projectile close to twenty miles. Primarily designed for the defence of unprotected parts of our seacoast, this mount ready for service with the gun in position weighed four hundred and thirty-six thousand seven hundred pounds. But one of these was built, for this was an experimental mount and not fated to be of service in the great war.

In a history of war achievements which must of necessity be written in superlatives to be in keeping with the facts, it is difficult to give proper emphasis and impossible to draw comparisons. But the cold figures suffice in this case to tell a graphic story. In sending forth six thousand seven hundred and fifty tons of these fighting monsters, the men of Berwick have won their service stripes!

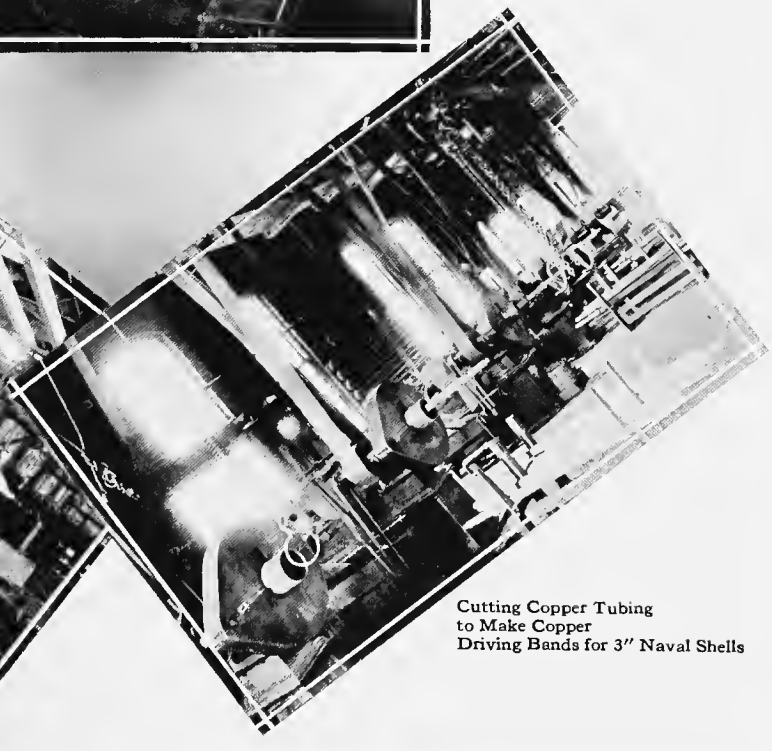


Submarine Net Buoys
Being Galvanized
and Washed

Artillery Vehicle
Wheels

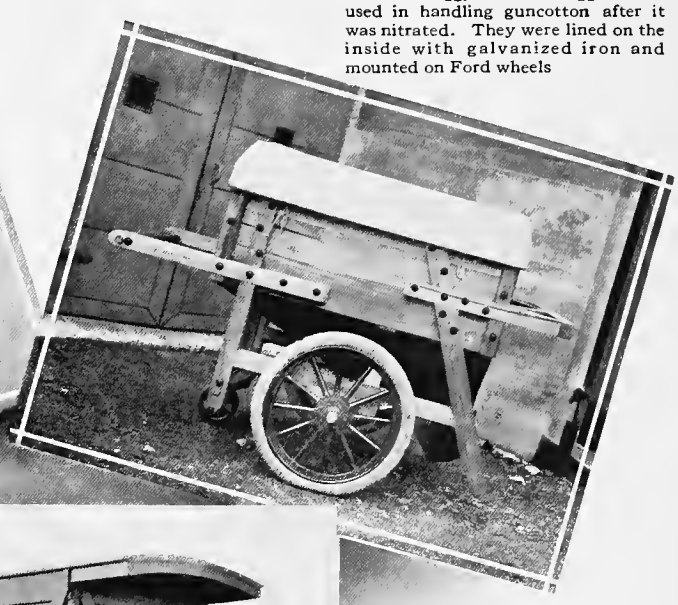
Applying an Axle
to an Artillery Vehicle

Submarine
Net Buoys
Ready to be Galvanized



Cutting Copper Tubing
to Make Copper
Driving Bands for 3" Naval Shells

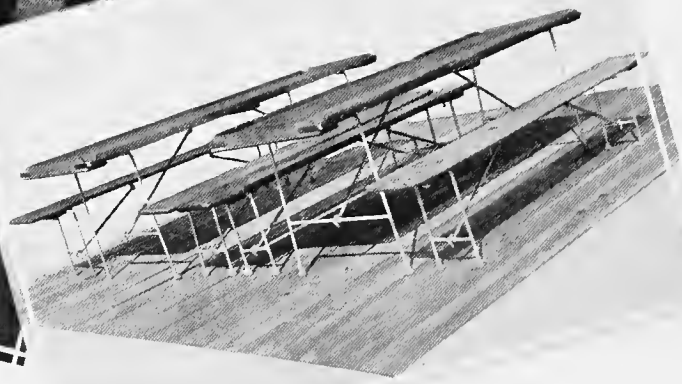
Acid Pot, Used in one Process of Nitrating Guncotton



Powder Buggy. These buggies were used in handling guncotton after it was nitrated. They were lined on the inside with galvanized iron and mounted on Ford wheels

Black Powder Car Used in Shell Loading Plant

Solvent Recovery Car used in the manufacture of smokeless powder. The object of this car was to reclaim the solvents consisting of ether and alcohol



Mess Tables and Benches Used in Outfitting Troopships

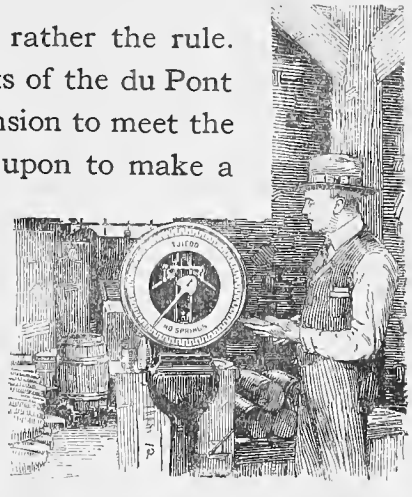
HELPING OTHERS TO HELP UNCLE SAM

THE most vivid imagination would hardly picture the war work of the American Car and Foundry Company as extending to the making of shirts for soldiers. As a matter of fact, however, Jeffersonville, among its many other martial activities, made possible the making of these shirts.

Across the river from Louisville was the great Jeffersonville Quartermaster's Depot, the largest in the world, where thirty thousand women faced the daily task of turning out twenty thousand shirts for Uncle Sam's fighting men. At this depot was an old-fashioned cloth-shrinking machine, as inadequate for its gigantic task as an old muzzle loading cannon would be for modern barrage fire. The limited capacity of this machine curtailed the output of the Amazons of Jeffersonville, and a more modern machine was not available anywhere.

And so the Quartermaster's Department appealed to the Jeffersonville plant of the American Car and Foundry Company. Within an incredibly short time, two of the most modern cloth-shrinking machines were delivered to the Depot, ready for their war work of shrinking millions of yards of cloth. Later came the production of more than two thousand cloth rollers, on which the cloth was rolled after it left the shrinking machine. And following this came the manufacture of cloth-laying apparatus, ingenious machines which automatically spread the cloth upon tables to facilitate the work of the cutters. Thus did Jeffersonville speed up the making of soldiers' shirts.

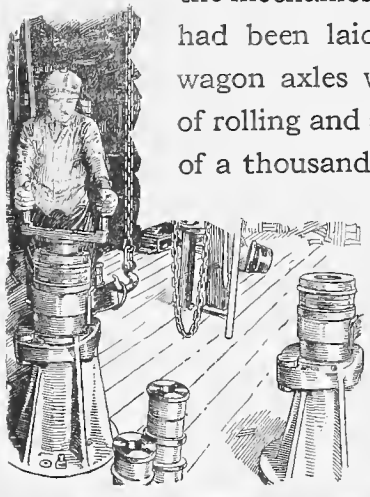
These neighborly actions were not the exception but rather the rule. The Wilmington plant was in close proximity to the plants of the du Pont Powder Company which were undergoing prodigious expansion to meet the demands for explosives. And so Wilmington was called upon to make a



vast amount of apparatus for this and other powder plants in the vicinity. Among the first of these services was the making of solvent recovery cars, used for recovering the solvent in which smokeless powder was dissolved. A solvent car consists of a framework of wood, mounted on trucks, and covered inside and out with steel and copper plates. One of them weighs over a ton, and Wilmington built more than five thousand of them. Miscellaneous powder cars, to the number of over seventeen hundred, each weighing about three tons, built of wood with steel trucks and reinforcements, took their place in the procession coming from the doors of Wilmington. Then came gun cotton storage cars, over five hundred of them and an equal battalion of powder dryhouse cars, with their frameworks of steel slides for trays on which the powder was spread to dry. Seven thousand welded steel acid buckets, and more than seventy-five thousand trays for powder cars, swelled the score which marked Wilmington's aid to the powder makers.

And the spirit of helping others to help Uncle Sam was as evident between the constituent plants of the Company as it was between these individual plants and their neighbors. Typical of this was the making at Jeffersonville of axles and wheels for the fifty thousand escort wagons that the St. Charles plant was producing for the Government.

The original method of making the forgings for escort wagon axles was found to be entirely inadequate to meet the enormous demand. The making of these axles as a blacksmith would ordinarily make them, and as Jeffersonville began to make them, hammering out the shape from hot metal and "upsetting" the collar, limited the output to one hundred and fifty per day—a considerable number, by ordinary standards, but for war needs, a mere bagatelle. So the engineers at Jeffersonville invented, through the stimulus of necessity, what they called the "rolls and upsetting machine." And when the mechanics at Jeffersonville carried out in iron and steel the thoughts that had been laid down on paper by these engineers, the making of escort wagon axles was no longer a matter of hammering and forging, but one of rolling and squeezing, in which a tireless machine delivered its daily quota of a thousand axles.

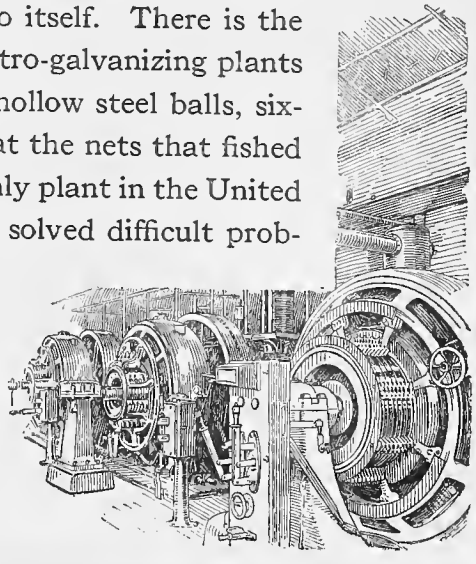


Then there was the matter of wagon chains. Beginning with comparatively small orders, the demand for chains of various lengths and sizes by the war wagon makers soon mounted to formidable figures. Presto, change, and the old blacksmith shop at Jeffersonville became a chain shop! Enlarged and equipped with twenty foot-power hammers and two chain link winders (these designed and built at Jeffersonville), ring winders and cutters, this rejuvenated smithy turned out more than three hunderd thousand chains.

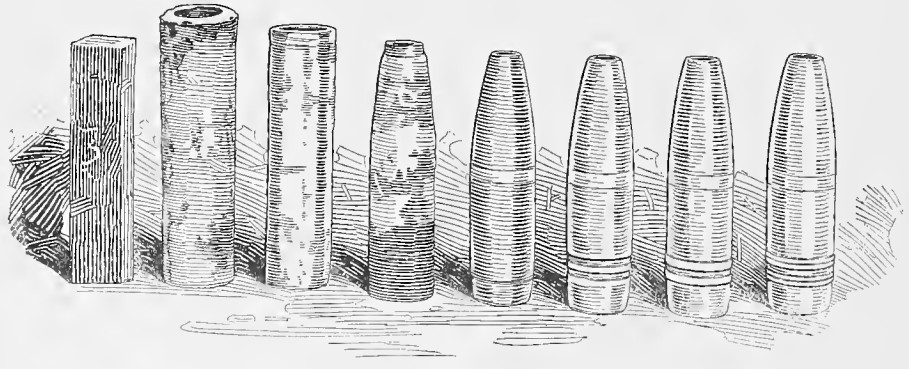
To build the hundred thousand wheels, which Jeffersonville contributed to the escort wagons that St. Charles completed, thousands upon thousands of feet of green hickory and oak required to be robbed of moisture, not by the slow agency of sun and air but through the torrid heat of the "dryhouse." The old dryhouse, with its daily capacity of two hundred and forty thousand feet was insufficient for the need, and so a new one sprung up, built of brick, steel and glass, and with a daily stint of seven hundred and twenty thousand feet of lumber. Deeds of this kind are quickly written and more quickly read, but it is difficult to tell in words what a vast volume of earnest effort precedes their accomplishment.

And mark the inter-relationship of the helping hand. For while Jeffersonville was forging axles, building wheels and making chains for the escort wagons built at St. Charles, St. Charles was in turn fashioning the chests and tompions, grindstone frames and packing strips for all of the artillery vehicles built at Detroit. Being exclusively a passenger car plant, the cabinet shop at St. Charles was particularly well fitted to fashion these accessories of wood which comprised hundreds of thousands of items.

Almost without end are the incidents that could be related in this story of the helping hand. Each one deserves a chapter to itself. There is the story of how Detroit, installing one of the largest electro-galvanizing plants in existence, built more than twenty thousand huge hollow steel balls, sixteen and a half and twenty inches in diameter, to float the nets that fished for submarines. There is a story in how Milton, the only plant in the United States to make large deliveries of toxic gas cylinders, solved difficult prob-



lems in the deep drawing of steel and delivered to Uncle Sam more than twenty-five thousand of these huge containers for the cryptic and terrible poison gases—gases that were held so secret that they were not named but were known by symbols such as X3 or N1. There are stories, and fascinating ones, in the making of seventeen miles of smokestacks for the Government cantonments; in the making of thousands of cast-iron cantonment stoves and more than twenty thousand all steel field ranges; in the building of pontoon bridge members for the Engineer Corps; in the manufacturing of nearly two hundred thousand washing and cooking boilers and one hundred and fifty thousand bake pans for the Commissary Department; in the building of trucks for airplanes and the making of brass drain plugs for submarines. Every one of these, and the many others that are set forth in the Statistical and Historical Notes, are romances of accomplishment. The tragedies and the comedies that went to make them, while not set down in written words, will live undimmed in the hearts and minds of those who made these romances come true and who helped others to help Uncle Sam.

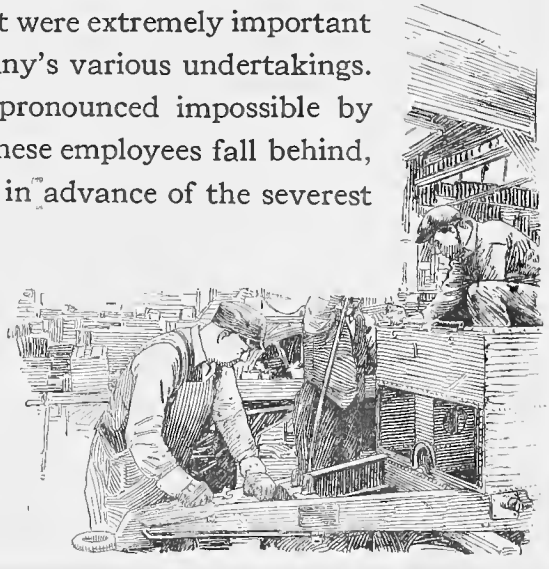


Progressive Treatment of Shell from Billet to Completion

KEEPING THE WAR WORKER ON HIS TOES

THE soul of an individual or a corporation is best developed by intentional planning. Haphazard growth does not give satisfactory results. The interest and enthusiasm which kept the war workers of the American Car and Foundry Company literally "on their toes" did not come by chance, but through conscious planning. Its results are measured by the fact that every day and every night of production was a day and night of battle and rivalry for honors, day gang against night gang, foreman against foreman, workman against workman, from the date that contracts were awarded to the date that they expired filled to the letter and with a surplus for safe margin. Each day marked a progressive increase in output. The last month's production was the biggest month's production, the last week was the biggest week, the last day was the biggest day, the last night was the biggest night and the last hour was the biggest hour.

In the nature of things most of the men who sought employment had had no previous experience at the plants where they were employed. Most of them had never seen a shell or an artillery vehicle or a railway gun mount. It was apparent that if war work was to be carried on successfully an esprit de corps must be developed. A sociological department was organized for this purpose and for social service. There is no question but that the spirit of plant pride, patriotism, enthusiasm and team work which developed through the efforts of this sociological department were extremely important factors in the successful fulfilment of the Company's various undertakings. For although schedules were made that were pronounced impossible by many men of long experience, yet not once did these employees fall behind, but on the contrary, on every contract kept well in advance of the severest schedule laid down for it.

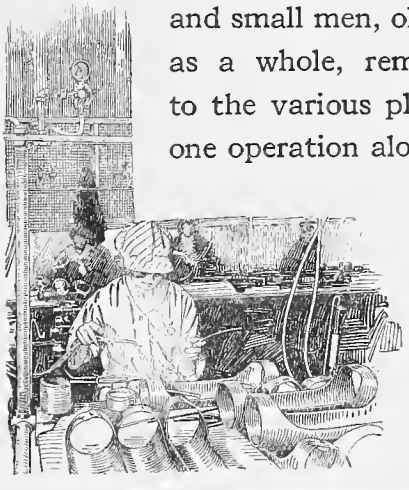


Knowing what you have to do and being told daily what you have done is the greatest of aids in accomplishing a given task. To this end organization charts were made up and definite lines of work assigned to each man, fixing his responsibility as well as his authority. Operation and time study charts were prepared covering in detail the progressive order of each operation to be performed. Weekly conferences and special meetings were called where officials and foremen met to discuss problems, solve difficulties and exchange ideas. Systems were devised whereby increased output and improved quality on work was substantially rewarded, while on the other hand a system of penalties discouraged careless, inefficient work.

If you had visited one of these great war plants during the peak of production you would have noted with interest the production blackboards that were maintained at each operation showing the previous day's hourly record on that particular operation in comparison with the current day's output. Here also you would find the number or name of the operator holding the previous day's high record.

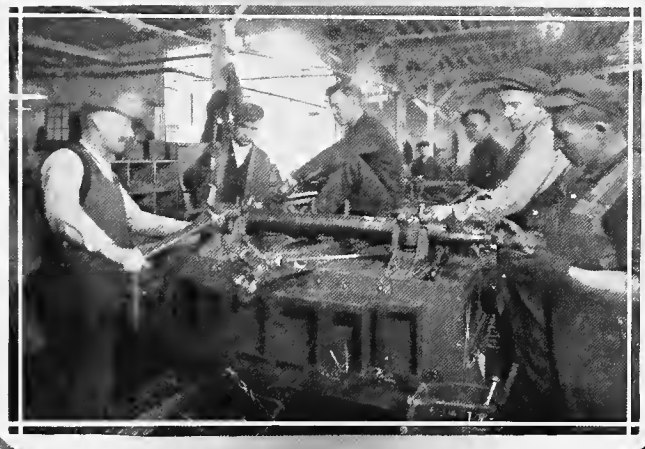
If you had entered the office of the plant manager you would have seen the hourly production reports giving the output by operations and also the output of individual machines. You would have seen the machine tool "condition board," a gigantic cribbage board, representing the production shop, the machines being shown in outline in their proper places and numbered. White pins indicated machines in operation, red pins those down for repairs and blue pins those that were idle for other reasons. You would have noticed that the red and blue pins changed their color to white with remarkable rapidity, following the corrective measures promptly taken to see that the "out of service" percentage did not rise above the accepted normal.

All kinds of men were engaged in the production department, big men and small men, old men and young men of all nationalities and colors, but, as a whole, remarkable for physical fitness and intelligence. Visitors to the various plants often asked, "Where do you find such men?" On one operation alone in the shell plant at Detroit were grouped twelve men

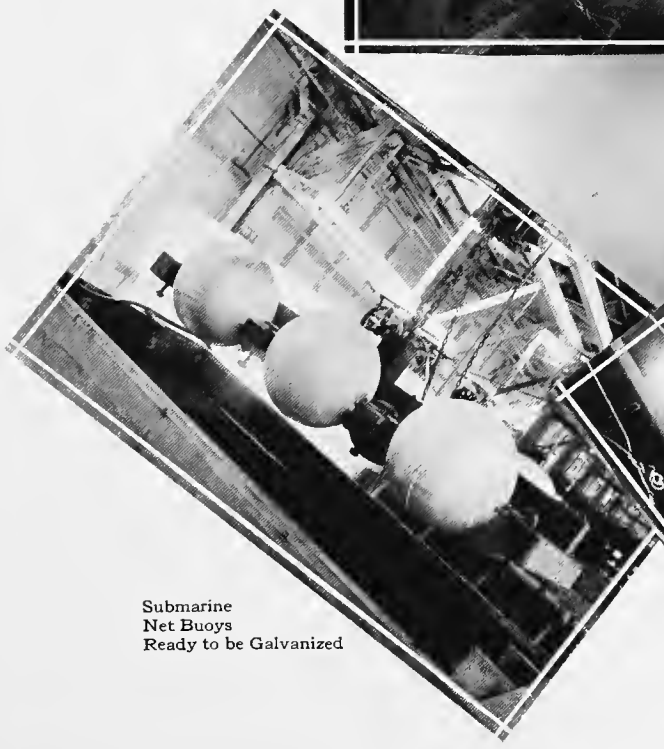


Submarine Net Buoys
Being Galvanized
and Washed

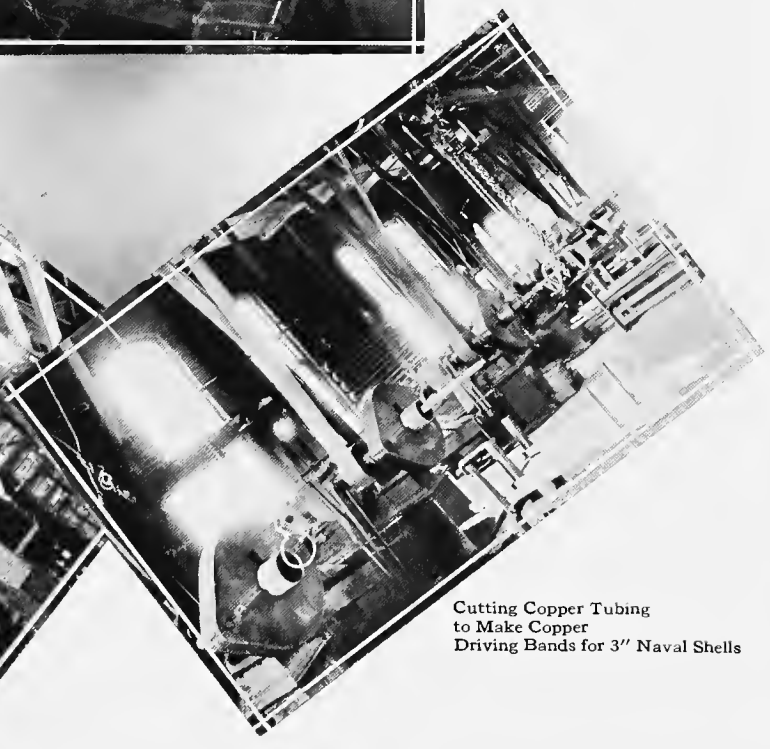
Artillery Vehicle
Wheels



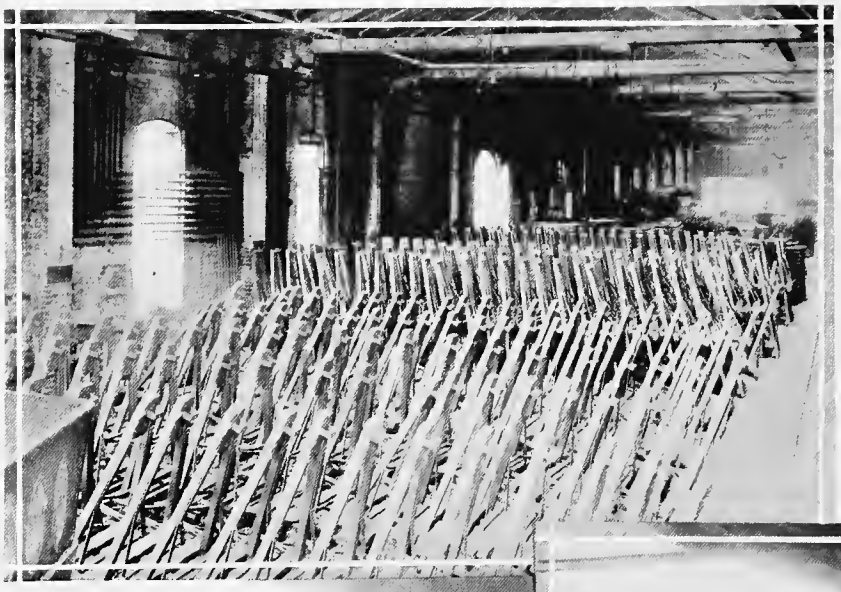
Applying an Axle
to an Artillery Vehicle



Submarine
Net Buoys
Ready to be Galvanized

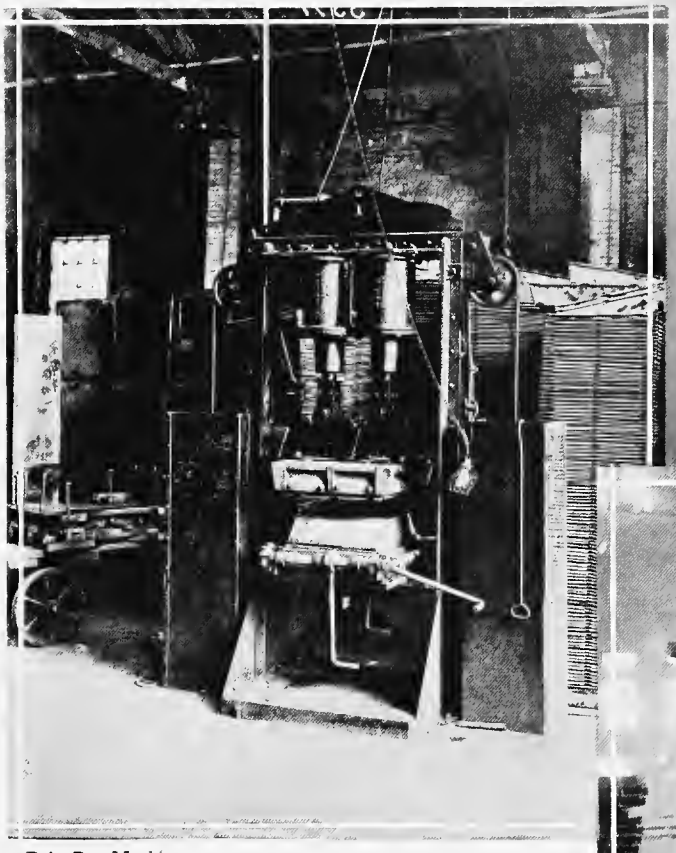


Cutting Copper Tubing
to Make Copper
Driving Bands for 3″ Naval Shells

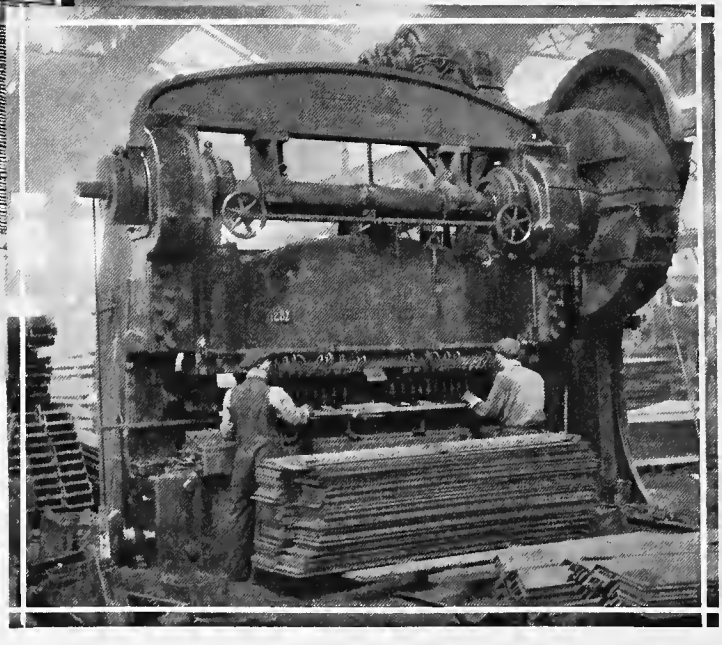


Complete
Escort Wagon
Running Gear

Feeder Chute



Bake Pan Machine



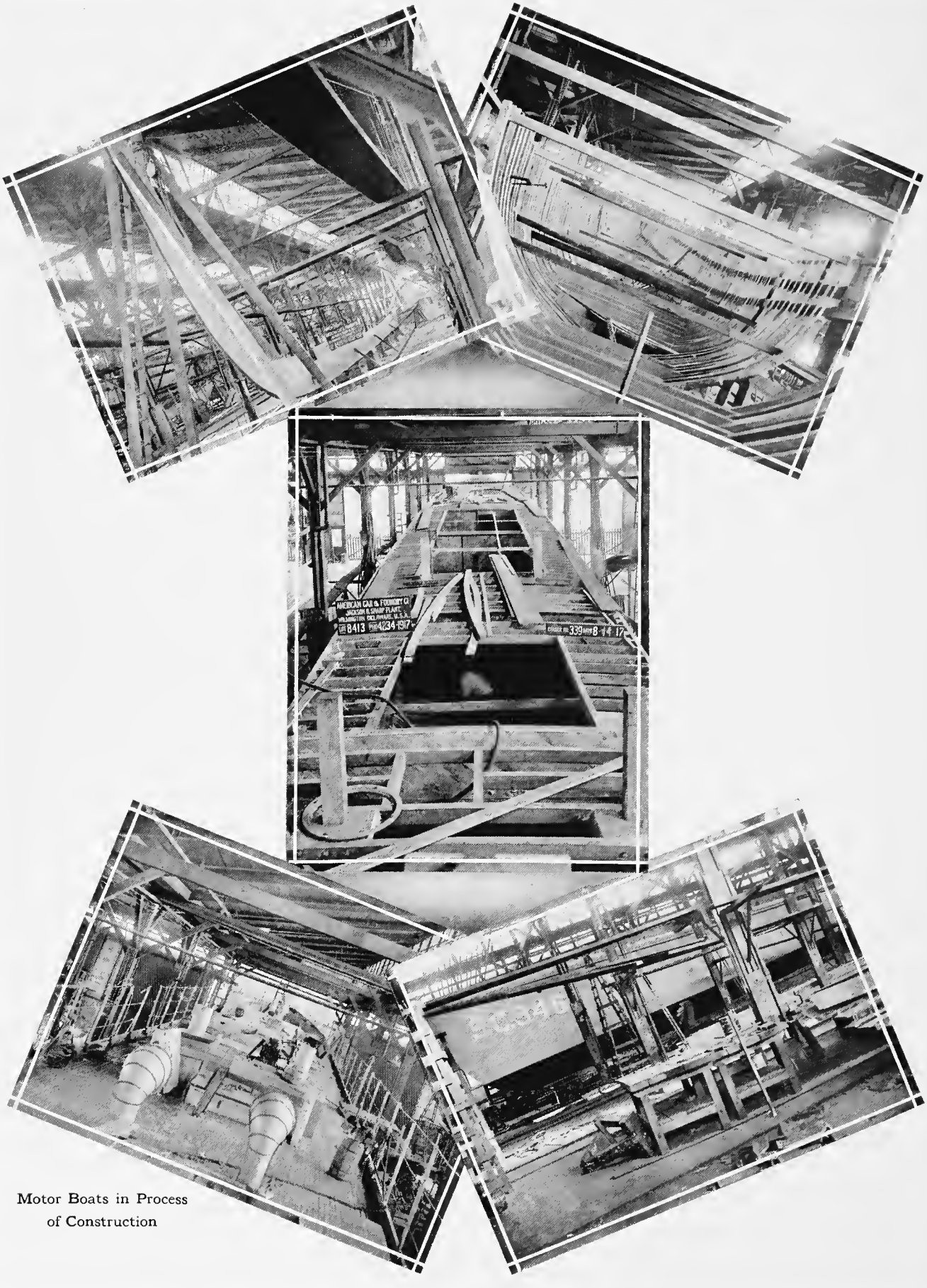
Punching

Making Wagon Chains

Wheel Shop

Pack Frame Parts

Welding Escort
Wagon Tires



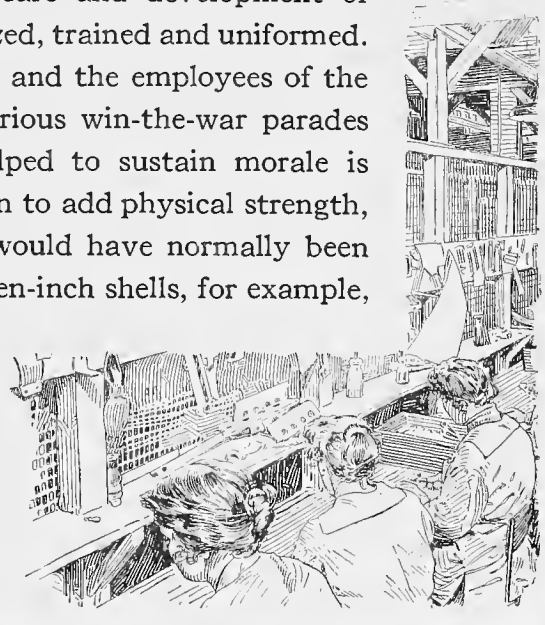
Motor Boats in Process
of Construction

varying in height between six feet and six feet ten inches, and in weight between one hundred and ninety and two hundred and sixty pounds.

On account of the uncertain duration of the war, mechanical means for handling the heavy shells was resorted to only in a very limited way. Shop space was at a premium and could not be spared for conveyor systems, hence the material was handled by man power; the shell forgings with single two-wheel trucks and the scrap in wheelbarrows. One man would wheel out from eight hundred to twelve hundred pounds of chips per load, in some cases for a distance of two hundred yards, and thus in ten hours would transport from ten thousand to thirty thousand pounds of chips, an almost incredible feat and one which eloquently bespeaks the high morale existing in the lower ranks.

The colored men in particular displayed almost childish eagerness in their war efforts to defeat the Hun. Some of them were employed in rolling the hot shells along the floor from the heat treating furnaces to the places where they were laid in rows to cool. It was hot, fast work and required dexterity, and many of these men talked to the hot shells as they rolled them. One of these was overhead to say to a companion, "Dat's right, Sid, talk to dem and talk fast." And Sid replied, "Sure, man, I'se gwine talk to dem, I'se gwine instruct dem how to behave 'mongst dose Germans."

At Detroit a monthly magazine, known as "Our Social Magnet," was issued. This was carefully edited, the patriotic thoughts and utterances by our foremost statesmen and military officials being given prominent expression. Particular emphasis was laid upon the ways of maintaining health, and instructions were printed for the care and development of home gardens. A band of forty pieces was organized, trained and uniformed. Patriotic concerts were given from time to time, and the employees of the plant headed by their band marched in the various win-the-war parades given in Detroit. That all of these things helped to sustain morale is indisputable. The spirit engendered seemed even to add physical strength, enabling the workers to accomplish feats that would have normally been classed as impossible. At one operation on the ten-inch shells, for example,



the machine attendant lifted the four hundred pound shell by means of a chain hoist a distance of four and one-half feet and placed it in the machine, performed the operation, gaged the work and finally lowered the piece to the floor. He did this for as many as one hundred to one hundred and twenty pieces in ten hours and hence handled from forty thousand to fifty thousand pounds through a distance of four and one-half feet, or expended over two hundred thousand foot-pounds of energy in a day's work, not considering the energy required to performing the actual cutting operation.

To provide warm and palatable food for the employees, kitchens and commissary buildings were built and food prepared and distributed to conveniently located stations in the various plants, from which it was sold at actual cost.

Women made an enviable record in the war work of the American Car and Foundry Company. One of them held the record for painting escort wagon wheels, finishing one hundred and ninety wheels complete in seven hours, this including giving them one coat of oil and two coats of olive drab paint. Special quarters were fitted up where the women could change from street clothes to shop clothes and vice versa, and rest rooms were provided.

Nothing was left undone to give the company employees, both men and women, every convenience and comfort, and the splendid spirit that they displayed in rising to the stress of the emergency proved without question that they were "on their toes," eager at all times to give all that they could give to help win the war.

There were quite a large number of women employed in the several plants of the Company in machining, painting artillery wheels, camouflaging artillery vehicles, soldering, and various other occupations. In addition, each plant had its own emergency hospital and the necessary number of nurses and attendants. At the Detroit plant there was a very large and competent Red Cross chapter.

The work done by these women was beyond criticism. They learned quickly and soon adapted themselves to any work given them. Their loyalty was inspirational and to their unflagging efforts is due in large measure the production achievements of the Company.

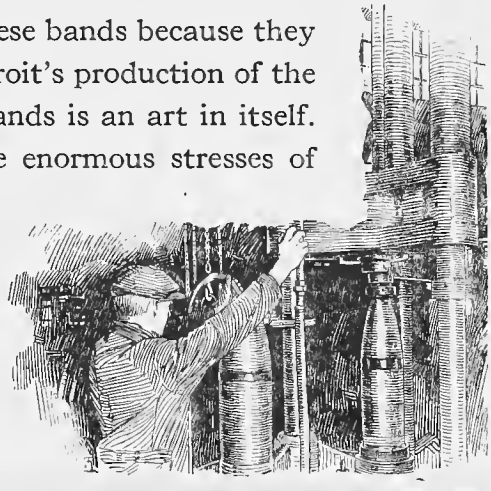
HOW INGENUITY WON ITS SPURS

THE general who must plan the strategy of battle and upon whose correct judgment rests victory or defeat is faced with scarcely more responsibility than is the plant executive who must direct the industrial battle of munition making. The correct selection of machines, the selection and training of a working force, the arrangement of processes and buildings, are things in which an error of judgment will prove fatal to the successful execution of the contracts. And the failure of a war contract means not merely loss of profits or the endangering of the lives of fighting men, but perhaps the prolonging of the struggle—perhaps the loss of the cause.

Each day the engineers and executives and workmen in American munition plants were faced with impossible tasks that had to be accomplished. Many such were faced by the men of the American Car and Foundry Company, and to their honor it must be said that each one of these tasks was met successfully. It was in such combats of mind against matter, man against time, that ingenuity won its spurs.

Typical of this was the making of copper driving bands at Detroit. Before a shell can be fired from a gun, its steel body must be embraced by a copper driving band whose function is twofold. This band accommodates itself to the spiral rifling in the bore that sends the shell whirling and spinning, true to its target. It also seals against the escape of powder pressure. Each shell, before one can call it finished, must have its copper band.

Detroit was faced with the problem of making these bands because they could not be obtained elsewhere in time to meet Detroit's production of the British 9.2-inch shell. The making of the copper bands is an art in itself. If too soft they will be torn from the shell by the enormous stresses of

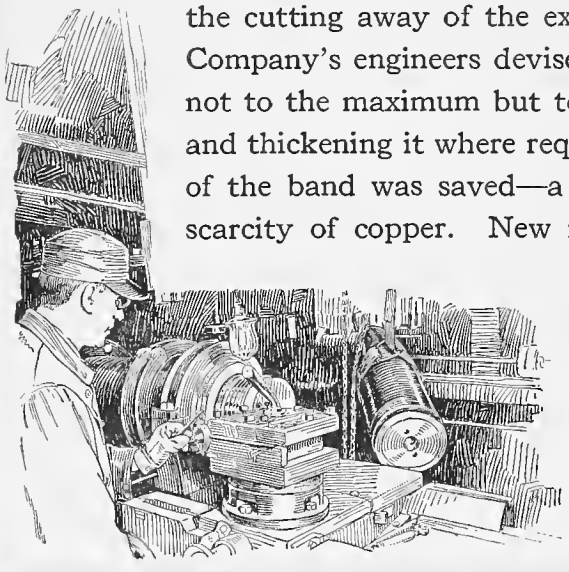


firing; if too hard they will crack when the great jaws of the hydraulic band seating machine squeeze them down upon the steel shell body.

Many trials and discouragements were met, but co-operation and determination overcame them all, until the production of copper bands at Detroit was greater than that of any other plant and sufficient not only to meet the needs of the American Car and Foundry Company's shell shops but also to supply a large demand in this country and for export.

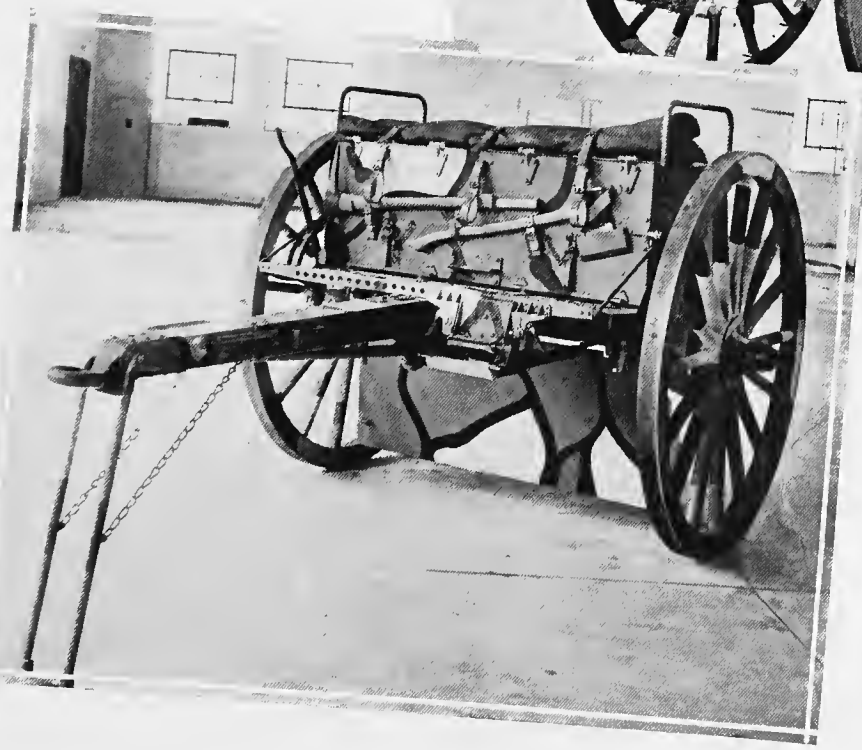
Copper came from the mills in the form of plates each twenty-eight inches square and a half-inch thick and each weighing one hundred and thirty pounds. From these square sheets, round blanks twenty-seven and a half inches in diameter were punched. Then came an operation in which a cup was made sixteen inches in diameter, ten inches deep and with a half-inch wall, and then three more operations in which this cup was deepened at the expense of the diameter until it became a tube ten inches in diameter and twenty-two inches long. From this tube five bands were cut for the 9.2-inch shell, and then the remaining piece was passed through dies which reduced it to eight and a half inches in diameter, again increasing its length. From this tube in turn three bands were cut for eight-inch shells and then three more passes through dies reduced the remainder to 4.94 inches in diameter. From this were cut five bands for 4.5-inch shells. Thus one flat copper plate, through the medium of ingenuity and powerful machines, became thirteen cylindrical bands for three different sizes of shells.

The 9.2-inch band when machined had a portion near one edge of greater diameter than the remainder of the band. Prior to the time that the Car Company undertook their manufacture, the rough bands were made of a uniform thickness equal to that required for the thickest part which meant the cutting away of the excess metal in the form of chips. But the Car Company's engineers devised ways and means for making the rough band not to the maximum but to the minimum thickness and then of enlarging and thickening it where required. Thus twenty-five per cent. of the weight of the band was saved—a most valuable accomplishment in view of the scarcity of copper. New methods of cutting the bands from the tubes



1

2



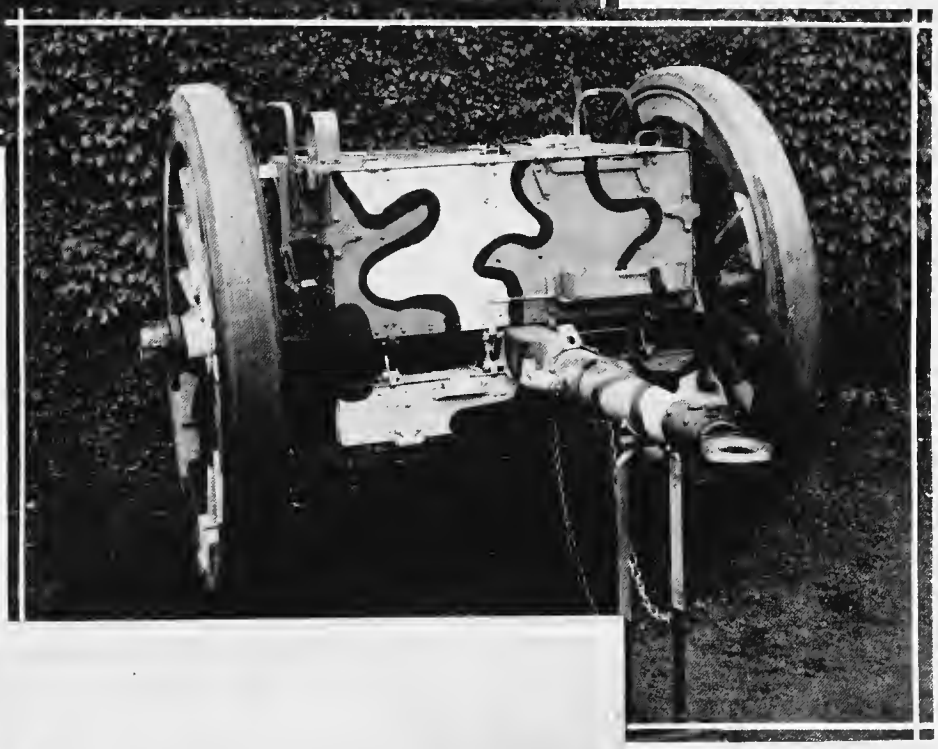
3

1 75 mm. Gun Caisson

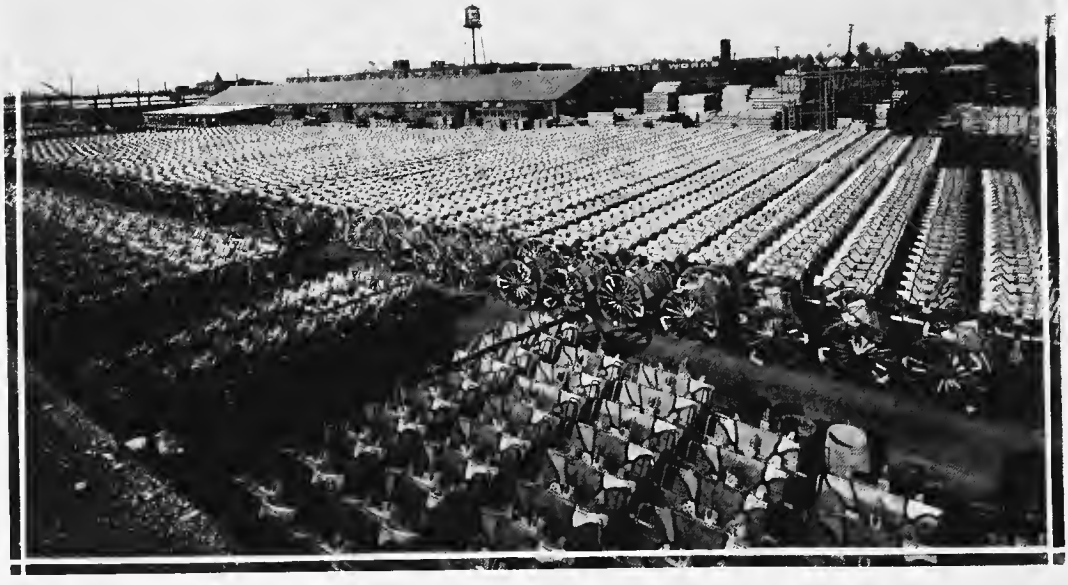
2 3-Inch Battery and Store Wagon

3 75 mm. Gun Caisson

Artillery Vehicles Stored—
Ready for Shipment



4.7-Inch
Gun Caisson



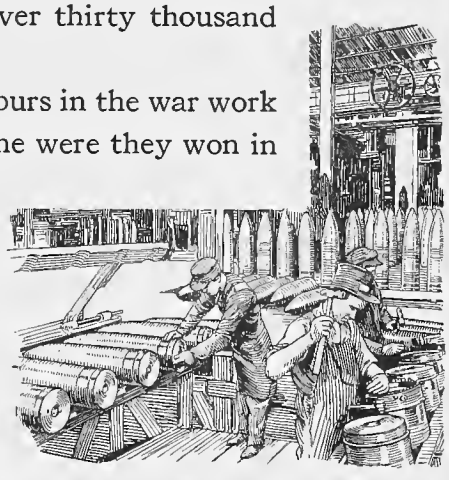
Thousands of Artillery
Vehicles Stored—
Awaiting Shipping

was also devised which accomplished the work with a minimum loss of material. Forty-five tons was the daily consumption of copper that Detroit thus cleverly and economically transformed into shell bands.

"Tin hats" for fighting men must resist the impact of an army automatic pistol bullet fired ten feet away from them. Their making is no easy task, for the manganese steel composing them is one of the toughest metals to form and to cut that is encountered by shop men and shop machines. But the engineers of Berwick found time between their tasks of building battalions of artillery repair shops and fleets of giant railway mounts to solve the difficult problems of helmet making. They did this so efficiently that five thousand helmets were made each day, each of which was capable of meeting this crucial bullet test.

In every one of the Company's plants ingenuity was put to its test. It came to Detroit with the making of heat treated shells, for the engineers and mechanics at this plant had had but little previous experience in this branch of metallurgy. Yet without resorting to expert assistance, and by methods devised wholly within the organization this problem was solved without the loss of a single forging. The test of ingenuity came from the necessity of cutting steel from shell forgings as steel had never been cut before and was met when the engineers of Detroit machined two shells in the time that one shell had formerly required. Their reward was not alone in the successful performance of their contract but also in seeing their methods duplicated in part and in whole in a large number of shell factories on both sides of the Atlantic. The test of ingenuity came when Jeffersonville invented its special cast-iron branding irons. Branders made of copper had always before been used for branding horses and mules but had made the flesh and hoofs sore and sensitive. So Jeffersonville made its special cast-iron and later its special wrought-steel branding irons, the first concern in the United States to make this type and making over thirty thousand of them.

It was in these many things that ingenuity won its spurs in the war work of the American Car and Foundry Company. Not alone were they won in



the forging of the thunderbolts of war, or in the machining of millions of projectiles, or in the building of the chariots of Mars, or in the making of sea scourers, or portable machine shops, or giant railway guns. They were won not only through the great accomplishments of which these things typify the final fruit, but they were won daily in planting and cultivating the seeds from which these and lessers fruits matured. For it was the successful doing of the daily tasks, the successful meeting of the daily problems that made possible the doing of the things that are set forth in this War Story of the American Car and Foundry Company.

In appreciation of the devotion shown by its men and women employees, the Company had an Honor Medal designed by a competent sculptor. These medals were awarded to 7,500 employees who gave their energies continuously to the production of war munitions up to the time of signing the armistice.

STATISTICAL AND HISTORICAL NOTES

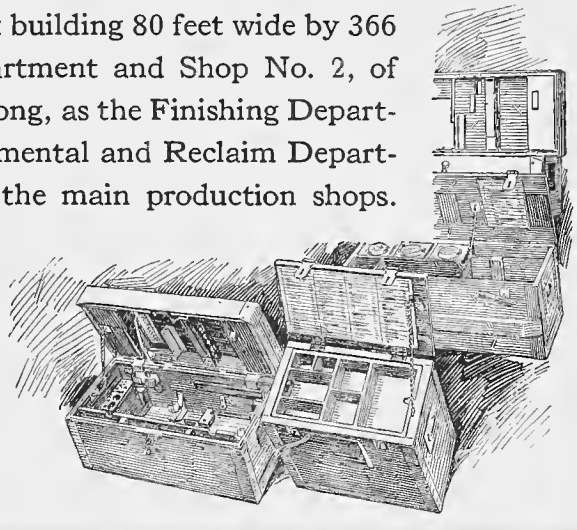
THE Berwick plant started the war activities of the American Car and Foundry Company. This plant began work on a contract for 300,000 Russian 3-inch high explosive shells early in June, 1915, and finished it on December 15, 1916, the order in the interim having been increased to 341,162 shells.

A total of approximately three million 3-inch projectiles was completed at Berwick, consisting of 341,000 Russian 3-inch high explosive shells, 2,432,000 U. S. Naval 3-inch common shells, 48,000 U. S. Naval 3-inch target shells, and 22,860 U. S. Naval 3-inch illuminating shells.

The equipment for the manufacture of these shells consisted of about 125 machines and also presses and furnaces suitable for the various operations, and necessitated the employment of 850 workmen, who turned out an average of six thousand complete shells a day.

Contracts were closed in September, 1916, with the British Government for forging and machining 75,000 9.2-inch and 45,500 8-inch high explosive howitzer shells, the machining contracts being assigned to the Detroit plant. On June 14, 1916, a third contract was received for 125,000 9.2-inch high explosive shells, and on August 1 of the same year an additional 310,000 were ordered, making a total of 510,000 9.2-inch and 45,500 8-inch British shells.

The freight car paint shops Nos. 1 and 2 were selected as production shops because they were of about the right shape and required a minimum of expense for preparation. Shop No. 1, a brick building 80 feet wide by 366 feet long, was laid out as the Roughing Department and Shop No. 2, of similar construction, 80 feet wide by 490 feet long, as the Finishing Department. Shop No. 3 was equipped as an Experimental and Reclaim Department and later was used as a "booster" for the main production shops.

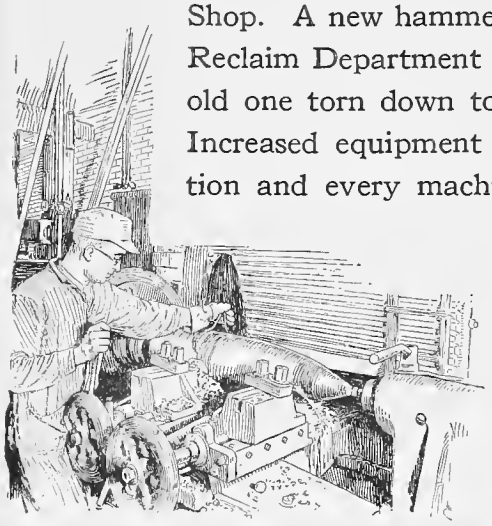


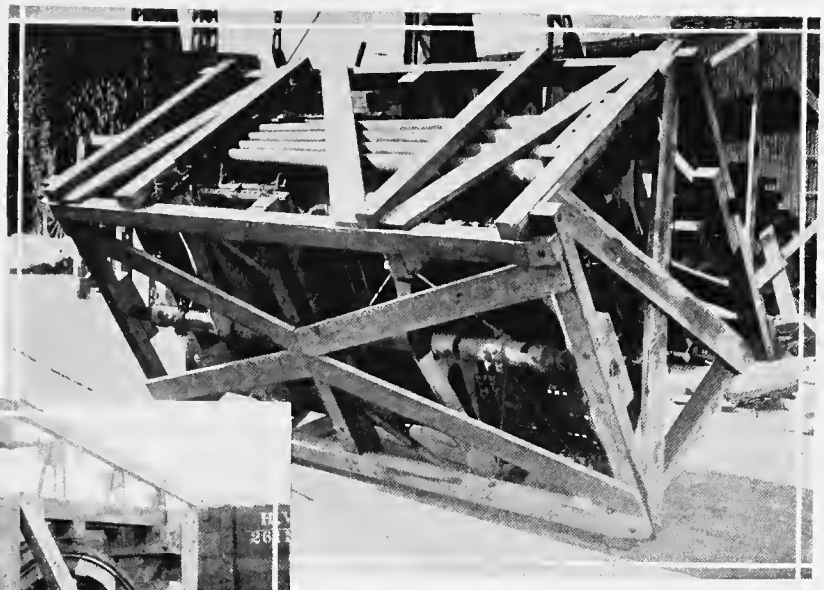
A portion of Shop No. 2 was first equipped as a tool room, but later the space was required for production and a new tool room 90 feet wide by 110 feet long was built and equipped for the manufacture and repair of tools and equipment.

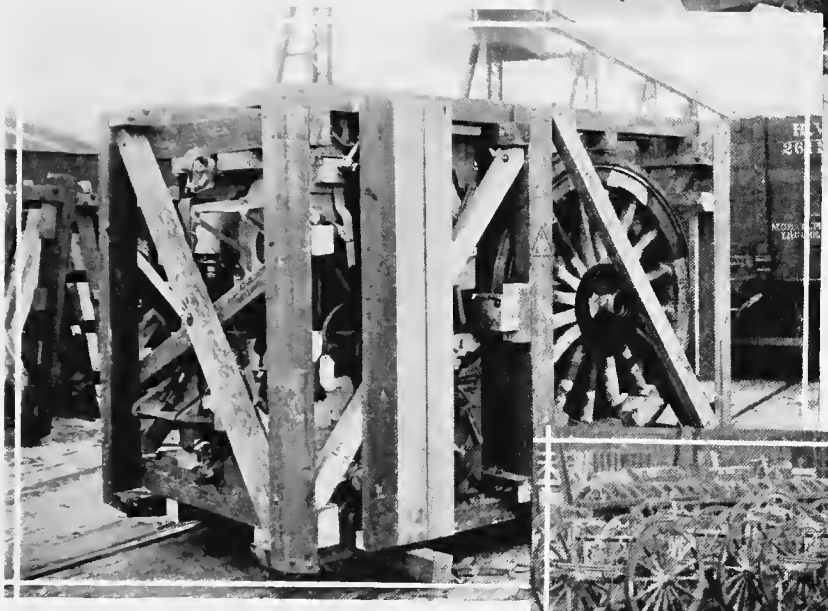
On December 18, 1915, three months after receiving the first contract, production started and on January 15, 1916, shipment was begun. On March 31, 1917, the expiration date of the last contract, the entire order for 555,500 8-inch and 9.2-inch shells was completed. During the last few months of this period a daily output of 3,500 shells was maintained, with occasional record of 4,500 per day.

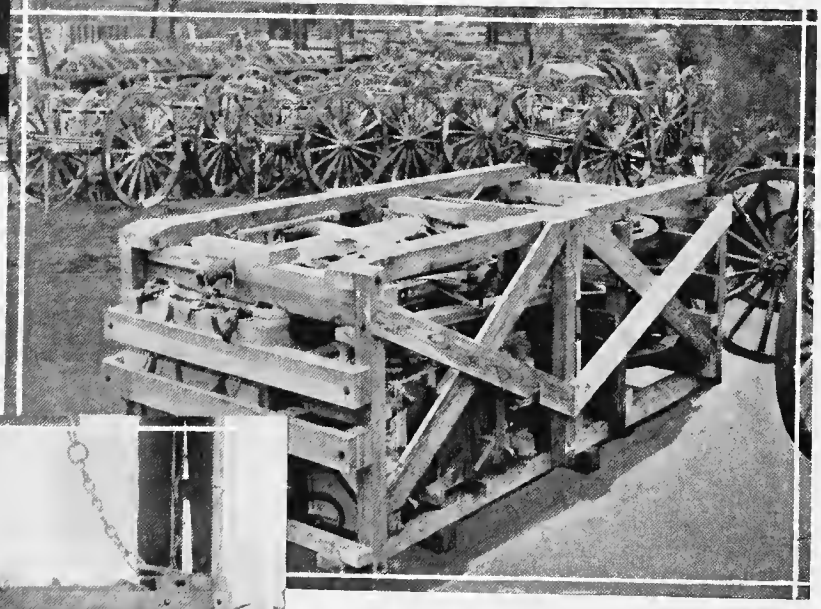
The first U. S. shell contract was assigned to Detroit on June 13, 1917. It called for 24,360 10-inch heat-treated common shells. By the time the shop had reached its scheduled daily production on this order, another contract for 60,000 10-inch shells was received. The output was increased until an average of 500 per day was reached, when an order for 400,000 9.5-inch shells was accepted in November, 1917. The output desired was 2,000 per day of these concurrently with 500 per day of the 10-inch. In January, 1918, the 9.5-inch shell was changed to 240 millimeters, and in April, 1918, an additional order of 215,000 10-inch shells was received. The production then requested by the Government was 1,000 240-millimeter and 1,000 10-inch shells per day. Work was immediately started on the shop layout and tool arrangement to increase the 10-inch output from 500 to 1,000 per day concurrently with a production of 1,000 240-millimeter shells per day.

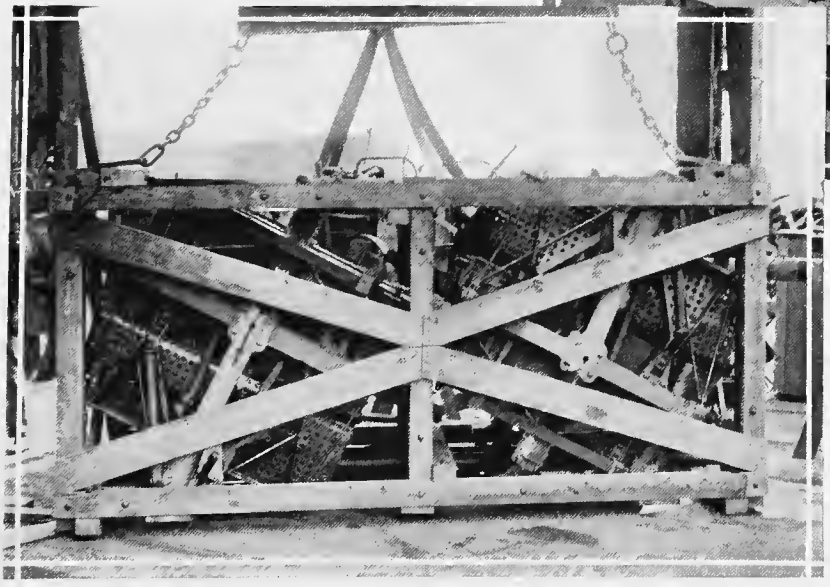
This schedule necessitated a large increase in space and machining facilities. Annexes were built on the side and on each end of the Roughing Shop No. 1 and a 100-foot addition was built on the north end of the Finishing Shop. A new hammer, annealing and heat treating shop was built, a new Reclaim Department organized, a new oil storage building put up and the old one torn down to make way for the addition of the Finishing Shop. Increased equipment was purchased for the 240-millimeter shell production and every machine tool in the Finishing Shop and a large number



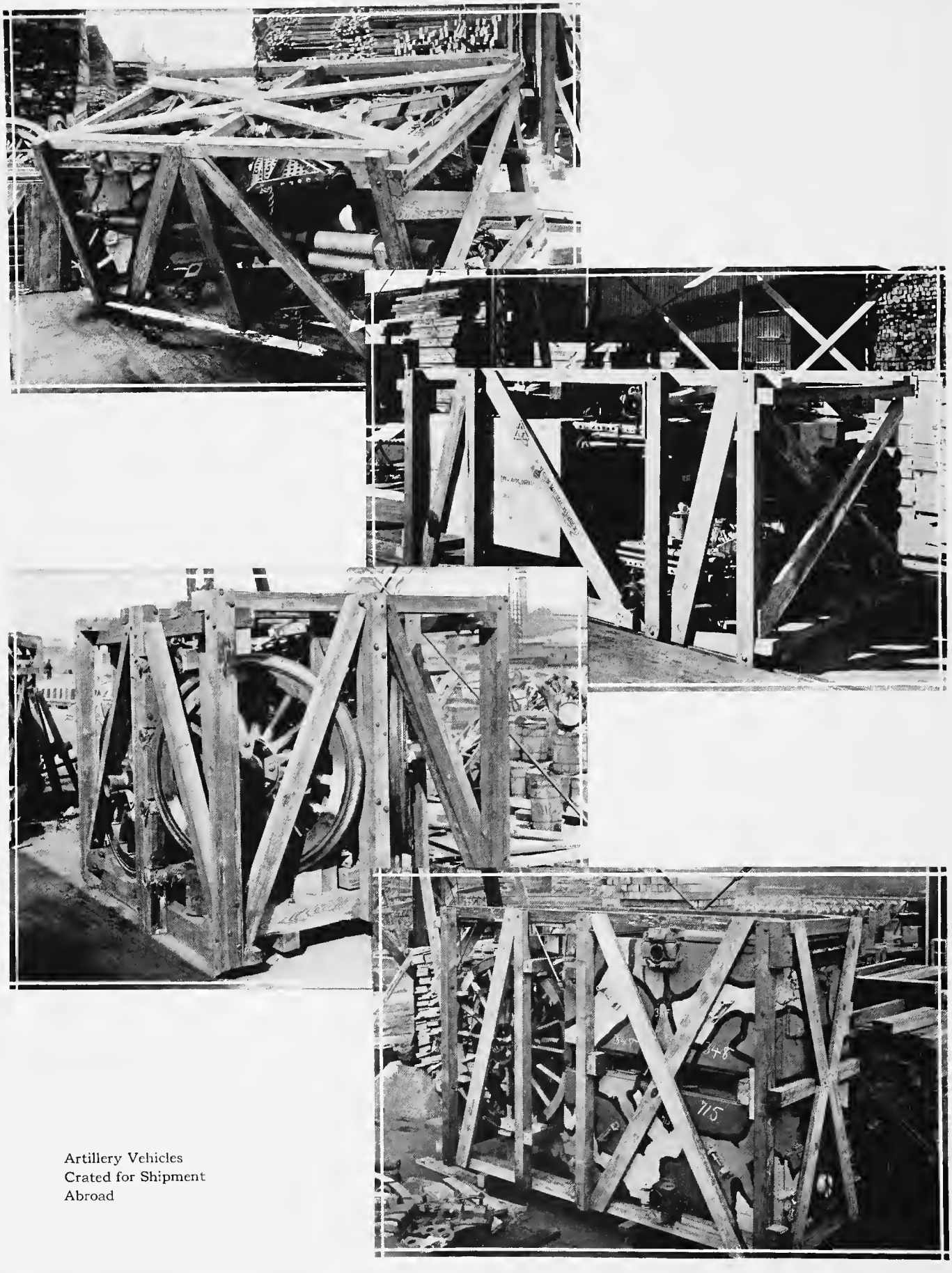








Artillery Vehicles
Crated for Shipment
Abroad



Artillery Vehicles
Crated for Shipment
Abroad

in the Roughing Shop were moved to permit running the 10-inch and 240-millimeter in parallel and to bring about a suitable sequence in the order of operations.

The schedule of 1,000 per day of each size was reached in September, 1918. It was announced in October, however, that the 10-inch shell was to be abandoned and the shop was to be swung over to a production of from 3,000 to 4,000 240-millimeter shells per day. Work to that end was under way when the armistice was signed on November 11, 1918, shortly after which permission was granted to proceed with a limited production of both types of shell.

From September, 1915, until the armistice was signed in November, 1918, the Detroit shell shops were operated 22 hours per day; 10 hours for the day shift and 12 hours for the night shift.

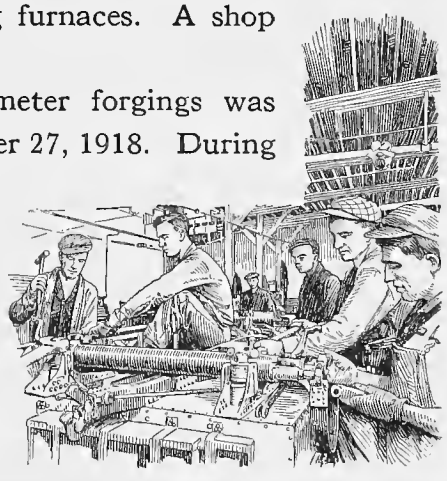
Shell Forgings Made at Detroit

In the fall of 1916, a British contract for 240,000 forgings for 9.2-inch shells was received. Production was begun in December of that year. All of the forgings made were shipped direct to England to be machined, and the contract was completed in May, 1917.

The first forging contract from the U. S. Government was received in November, 1917, and was for 1,750,000 155-millimeter shell forgings. This contract was divided between the Detroit and the Depew plants. It was followed in January, 1918, by a contract for forgings for 90,000 240-millimeter shells.

This required the installation of a new forging plant, consisting of four 400-ton and two 775-ton presses; six motor-driven pumps; an accumulator, the ram of which was loaded with 875,000 lbs. of dense iron ore to give the required pressure and a battery of eleven heating furnaces. A shop area of 92,000 square feet was occupied by this plant.

By February, 1918, the production of 155-millimeter forgings was started, and Detroit's quota was completed by November 27, 1918. During



September, the daily average was 6,200 forgings, and on some days over 7,000 were turned out.

In all, 851,340 forgings were shipped from the Detroit plant, distributed as follows:

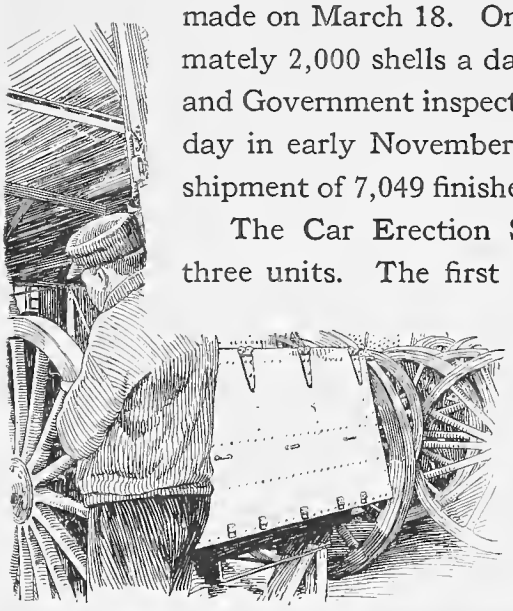
Depew Plant	426,342
Detroit Shell Co.	250,000
Harroun Motors Corporation	100,000
Jackson Munitions Co.	35,216
International Arms & Fuze Co.	25,000
Army Reserve Depot, Columbus, O.	14,782

As the 240-millimeter shell forgings were to be made as a reserve supply for Detroit, in case of any interruption in the flow of forgings supplied by the Government, production was not begun until September, 1918, and then at the rate of about 500 per day. Work on this contract was suspended after the signing of the armistice, a total of 19,261 having been completed.

In addition to making forgings for shell bodies, 30,528 forgings for base plugs were made at Detroit in connection with the British shell contract, and about 206,000 forgings for nose plugs for the U. S. 10-inch shells.

Making 155 Millimeter Projectiles at Depew

The initial order was for 970,000 shells. On receipt of forgings from Detroit, the manufacture of shells was begun on February 21, 1918. The first shell was finished on March 1, and an initial shipment of twenty was made on March 18. On April 30, the Depew plant was producing approximately 2,000 shells a day, had placed more than 41,000 shells in operation, and Government inspectors had passed 12,500 shells for shipment. A record day in early November marked the production of 6,575 forgings and the shipment of 7,049 finished shells.



The Car Erection Shop at Depew was divided for war work into three units. The first was cleared of all car work and a new floor laid,

while car repair work was temporarily continued in the remaining two units. At the time the machinery was being installed in Unit No. 1, the entire car apparatus and tracks were removed from Unit No. 2 and foundations put in for new machinery. Unit No. 2 was approximately fifty per cent. completed before the car work was finally removed from the third unit.

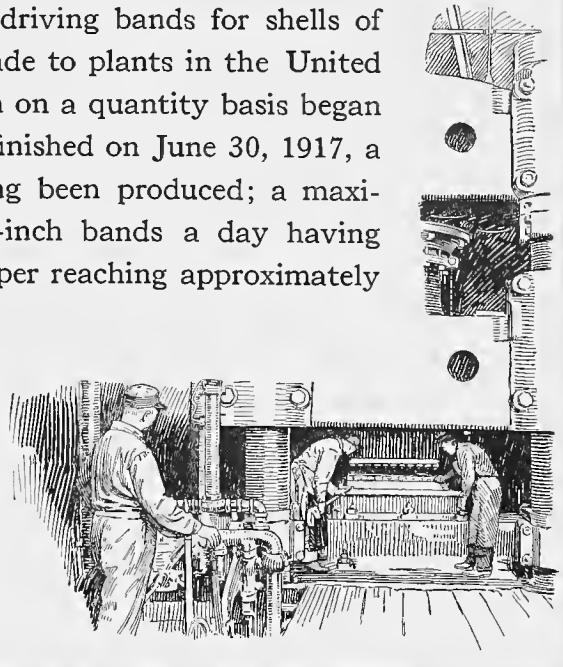
Approximately 460 machines of various types were installed together with their necessary foundations, overhead rails, belting, electric motors, lights, and wiring.

The Steel Underframe Shop was chosen for the forging department. Concrete tanks were built for the storage of oil, and pipes were installed for conveying it to the furnaces. A large number of small trucks for carrying billets had to be constructed, and two transfer tables were erected. Four hydraulic pumps were installed to furnish power for the presses. Two hydraulic accumulators were installed, one with a total weight on its foundation of 970,000 pounds, the other having a total weight of 633,000 pounds. The six presses in the forge shop were capable of exerting a pressure of 500 tons each. Three distinct departments were created for acetylene welding, grinding, hardening, and the tempering of tools.

In eleven months Depew completed 970,000 finished shells and 616,000 shell forgings.

Detroit's Production of Copper Shell-Bands

Seven contracts, totaling 2,910,000 copper driving bands for shells of various sizes were booked, shipments being made to plants in the United States, Canada, and Great Britain. Production on a quantity basis began on December 11, 1915. These contracts were finished on June 30, 1917, a total of 3,465,500 bands of various sizes having been produced; a maximum of 5,000 9.2-inch bands and 40,000 4.5-inch bands a day having been attained and the daily consumption of copper reaching approximately forty-five tons.



Making Fifty Thousand Artillery Vehicles

The Detroit plant received three major groups of vehicle contracts. The first, on June 5, 1917, was for vehicles to complete 3-inch and 4.7-inch gun batteries. Included in the 3-inch battery vehicles were 661 gun carriage limbers, 3,348 caissons, 3,348 caisson limbers, 333 battery wagons, 333 store wagons, 333 forge limbers; while the 4.7-inch vehicles included 433 gun carriage limbers and 1,848 caissons.

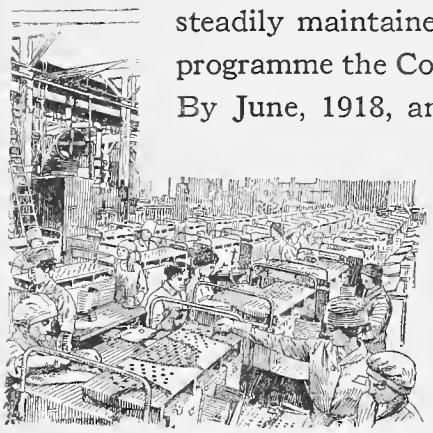
In August, 1917, a second group of contracts was received covering the following vehicles, all for 75-millimeter gun battery: 800 gun carriage limbers, 2,400 caissons, 2,400 caisson limbers, 200 battery wagons, 200 store wagons, 200 forge limbers, 200 store limbers. These contracts covered a total of 6,400 vehicles, all of which were duplicates of the vehicles covered by the first group.

A third group of contracts was received in December, 1917, and included the following, all for 75-millimeter gun battery and duplicates of the previous lots: 2,053 gun carriage limbers, 14,608 caissons, 14,368 caisson limbers, 1,338 battery wagons, 1,122 store wagons, 1,338 forge limbers and 1,122 store limbers.

The total of these contracts was 35,949 vehicles, and the grand total of all of the artillery vehicles on order at the Detroit plant was 53,319.

In July, 1917, October, 1917, and February, 1918, contracts were received for War Reserve Parts, Replacement Vehicles, etc., in which were included duplicate parts of the vehicles, the quantities of some individual items running into the hundreds of thousands of pieces. Other miscellaneous orders for artillery vehicle materials were given the Company at various times by the Ordnance Department, the principal of which were 2,936 75-millimeter axles, and 1,165 4.7-inch axles.

By April, 1918, the promised delivery of 100 vehicles per day was being steadily maintained, but by reason of the expansion of the Government's programme the Company was called upon to increase the output to its limit. By June, 1918, an output of 200 per day was attained; by September 1,



1918, 250 per day; and at the cessation of hostilities, in November, 1918, 275 completed vehicles and spare parts equivalent to 25 full vehicles, or an output of 300 vehicles per twenty-four hours was the regular schedule.

Work on these contracts was terminated by order of the War Department, at which time out of 53,319 vehicles ordered, a total of 47,825 had been completed and accepted.

Simultaneously with the designing and making of tools, the machines required for the manufacture of the vehicles were purchased and installed, there being about 475 in all.

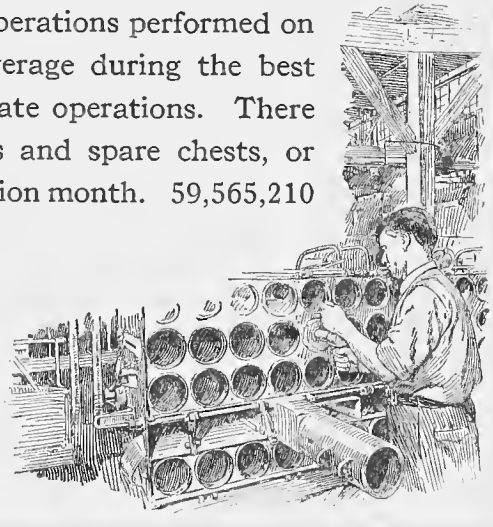
For the maintenance of the tools a department, having an area of about 6,000 square feet and more than 50 machines, was operated throughout the working period.

It became necessary to make additions of 42,000 square feet each at both ends of the former car-erecting shop and to construct a new building, 160 feet wide by 320 feet long, for the finishing and painting of vehicles and also to add 18,500 square feet to the storehouse for supplies. It was necessary, in addition, to build a warehouse for tools and accessories, which covered 18,000 square feet.

A special department was organized for boxing and crating the product, four buildings were erected for this purpose, two having an area of 7,200 square feet, one of 4,300 square feet and one of 1,800 square feet. A building 300 feet long, in which was a five-ton overhead electric traveling crane of 40 feet span, was erected from which to load the vehicles into cars.

For making vehicle axles, an area of 60,000 square feet was required and 225 machines were purchased and installed for this purpose, involving the construction of foundations, erecting of shafting, belts, wiring and piping systems for compressed air and lubrication.

To summarize, there were 163,855,137 separate operations performed on parts for vehicles and spare chests. The daily average during the best production month was approximately 900,000 separate operations. There were 173,779,668 holes drilled in parts for vehicles and spare chests, or 954,000 holes drilled each day during the best production month. 59,565,210



rivets were driven in vehicles and spare chests, or a daily average of 328,000 during the best production month. 28,933,100 separate pieces, exclusive of rivets were handled and assembled in vehicles. In addition, there were 5,368,000 separate pieces manufactured for battery spares and war reserve spare parts. This gives a daily average during the best production month of 189,000 pieces manufactured.

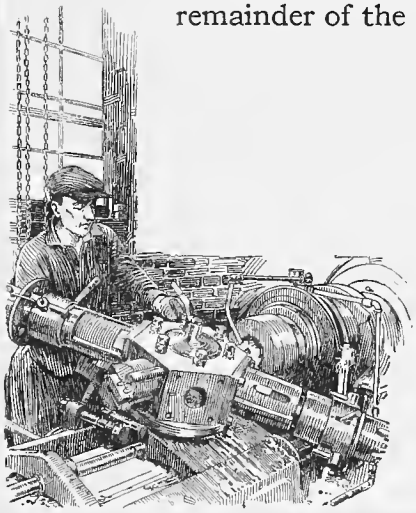
The construction of these vehicles required 265,679 steel castings weighing 5,584,784 pounds; 638,090 bronze castings weighing 1,188,095 pounds; 41,154 grey iron castings weighing 823,080 pounds; and 58,941 aluminum castings weighing 6,549 pounds.

Berwick's Motor Trucks

On October 1, 1917, came an order from the U. S. Government for building bodies for 120 equipment trucks and 384 artillery repair trucks. On November 21, 1917, an order was received which covered the application of the body to the chassis and the installation of machinery on the artillery repair trucks. One dated January 11, 1918, provided for furnishing and applying conduit roofs to equipment trucks, and this was followed by another dated February 18, 1918, requiring the application of air-compressor tanks to the artillery repair truck bodies.

Then came still further contracts in 1918, as follows: February 20, 700 artillery repair trucks; March 18, 248 artillery repair trucks; March 28, 60 equipment bodies; April 15, 118 equipment bodies; June 13, 576 trailer trucks; and on August 7, 624 heavy artillery mobile repair trucks.

Of the artillery repair trucks, the Berwick plant drivers took 82 and Government drivers 928 to Philadelphia under their own power. The remainder of the 1,332 and the 48 motor train units were shipped by rail.



Making Monster Railway Gun Mounts

The initial contract was for twelve mounts, Model 1918-MI, and was dated April 27, 1917. The Car Company was obligated to deliver a sample mount by August 13. Work in the shops started early in May, but hardly had it begun when Berwick began receiving urgent requests to anticipate delivery. After extraordinary effort, the first car was completed and shipped from the Berwick shops on June 23, 1917, more than 50 days ahead of schedule.

Seventy-seven Model 1918-MI gun cars were built on the contracts of April 27, 1917, and December 13, 1918. One Model E car was built on a Government order dated August 10, 1917.

In addition to the contracts for various models of gun cars, the following miscellaneous items were ordered by the Government: Tools and accessories for eleven 7-inch Navy mounts; spare parts for eleven 7-inch Navy mounts; tools and accessories for sixty-five Model 1918-MI gun cars; spare parts for forty-six 8-inch gun cars; spare parts for seventeen 12-inch motor cars; and two complete units of spare parts for ammunition cars.

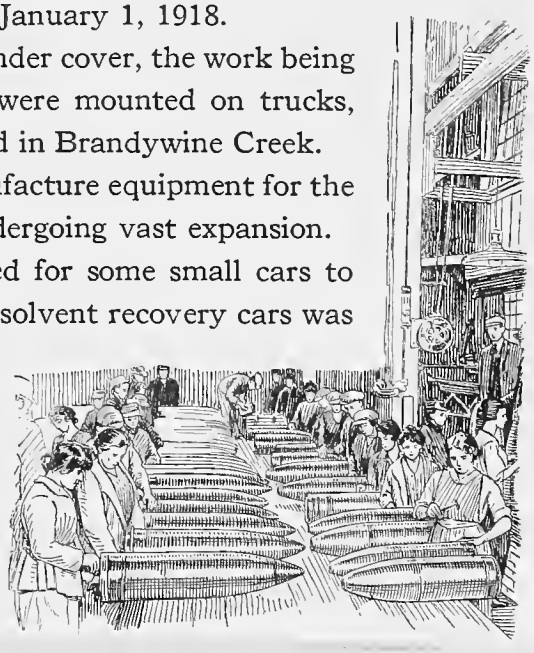
Wilmington's Submarine Chasers and Its Other War Work

A Government contract received April 30, 1917, specified that two submarine chasers should be delivered within seven months and that six additional chasers should be delivered not later than January 1, 1918.

All of these chasers were built in the car shop under cover, the work being done for the most part by car builders. They were mounted on trucks, hauled by locomotive for half a mile, and launched in Brandywine Creek.

The Wilmington plant was called upon to manufacture equipment for the du Pont and other powder plants which were undergoing vast expansion.

The first order received in March, 1915, called for some small cars to haul acid tanks. In May an initial order for 348 solvent recovery cars was



received. Altogether 5,695 solvent cars were built and delivered to munition works. Miscellaneous powder cars to the number of 1,772 were manufactured. These cars were built principally of wood with steel trucks and reinforcements. They weighed about 6,000 pounds each. Some 600 shell carriers, used in munition plants for handling and loading shells, were also made.

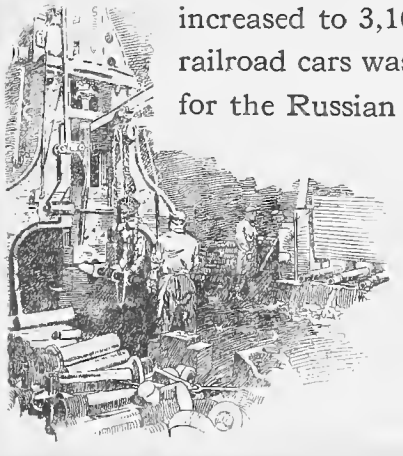
Among other articles furnished by Wilmington to various powder companies were: 573 gun cotton storage cars; 50 dope trucks (used for carrying cotton after it is partly made into gun cotton); 7,033 welded steel acid buckets; 556 power dryhouse cars; 20,000 trays for powder cars, and 55,985 miscellaneous trays.

In the car department a thousand complete field ranges were built. These were all steel, weighing 160 pounds each. The contract for these was awarded on May 31, 1917, and they were finished in November, 1917.

Following are other articles manufactured at Wilmington plant: 120 airplane trucks; 8,372 mess tables; 18,697 mess table benches; 348 trestles (pontoon bridge equipage); 12,450 long balks (the technical name given a piece of Douglas fir wood that acts as a stringer for pontoon bridges); 1,260 short balks; 48,310 long chesses (cross boards of white pine for pontoon bridges); 4,104 short chesses; 660 cypress sills; 624 white pine saddle transoms; 144 pontoon chests; 36 spare cover boxes; 348 cap levers (used for lifting the supports at the trestles of the approach to a bridge); 2,784 pickets (wooden stakes driven in bank to keep the current from washing boats down stream); 144 pontoons, and 4,150 smoke boxes.

Jeffersonville's Contributions to the Cause

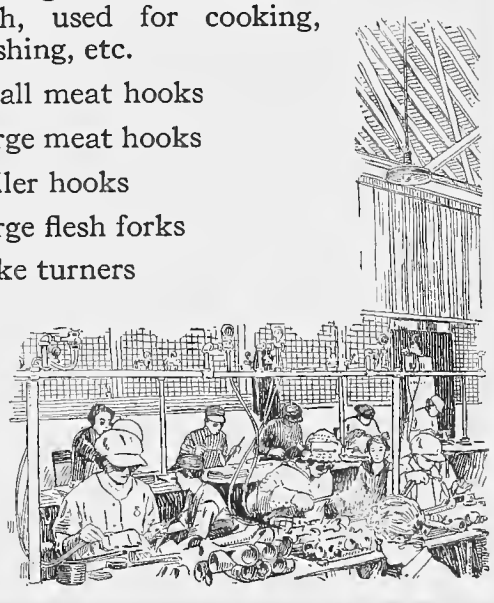
The first Government order was dated December 15, 1915—during the Mexican disturbances—and was for 400 cast-iron candlesticks, double pointed, to stick on a tent pole or in the ground. This order was later increased to 3,166. In July, 1915, an initial order for couplers for Russian railroad cars was received. This was followed by other orders for car parts for the Russian and Italian Governments.



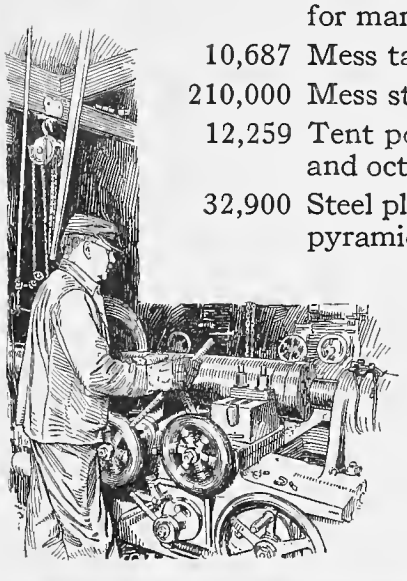
The escort wagon wheel department was housed in the old caboose shop. A new dry house, built of brick, steel, and glass, was erected and operated in conjunction with the old one. This building was 100 feet by 240 feet and had 12 drying compartments, each having a capacity of 60,000 feet of unseasoned lumber. To expedite forging, 7 additional steam hammers were installed, ranging in size from 2,500 pounds to 6,000 pounds, while many new trimming machines were also found necessary.

Other Articles Manufactured at the Jeffersonville Plant

3,500	Escort Wagons, complete.
1,250	Bodies, or beds
4,700	Axle beds
1,840	Bolsters
8,000	Sides
3,730	Tail gates
5,450	Seats
2,450	Springs for seats
700	Ridge poles
1,535	Feed and tool boxes
250	Tool and wheelright chests
150	Ration carts
56	Powder cars
1,100	Solvent recovery cars
181,042	Forgings for base plugs for 10-inch shells
47,310	Forgings for nose adapters for 240-mm. shells
23,972	Army field-ranges, with boiling plates and Alamo attachments
18,035	Alamo attachments
4,814	Boiling plates
760	No. 3 Army ranges—six holes
61,789	Pan rests for army ranges
1,054	Left tile linings for army ranges
600	Dorsey oil burners, for field bakeries
400	Fire hooks, for cleaning ranges and bakeries
5,426	Tent guards, for army ranges
800	Tent shields
4,000	Tent hoods
100	Pipes, upper and lower, for field bakeries
910	Pan hooks, for field bakeries
431	Incinerator pans
191,356	Boilers, round and square holding from 6 to 20 gallons each, used for cooking, washing, etc.
13,747	Small meat hooks
288	Large meat hooks
250	Boiler hooks
2,262	Large flesh forks
18,156	Cake turners



50,012	Large and small perforated skimmers
143,271	Tin dippers, one and two quart
433	Sheet iron dough troughs, 6 feet long, 2 feet deep, 2 feet wide at bottom and 3 feet wide at top
16,553	Dam and moulding boards for dough troughs
1,296	Moulding board stands
16,311	Sponge cans, used for "setting" bread
1,772	Sponge can covers
153,586	Bake pans, large and small
12,460	Tongues
4,060	Double-trees
4,200	Single-trees
30,310	Coupling-poles
12,204	Brake levers
2,620	Brake beams
33,670	Brake blocks
4,500	Brake shoes
3,400	Axle wrenches
17,000	Hubs
5,500	Sets of fire irons for march kits, used when cooking in the open
32,200	Camp kettles, with covers, for march kits
10,687	Mess tables
210,000	Mess stools, 4 legged
12,259	Tent poles, round, square, and octagon
32,900	Steel plates and chains, for pyramidal tents



2,055,154	Brass tent slips, for fastening tent ropes
475,000	Aluminum shelter-tent pins
2,000	Sheet iron tent stoves
1,805	Joints of stove pipe
121,092	Folding army cots
930	Cot straps, with buckles
112	Sixty-two-inch Aparejos pack-saddle back frames, to fit on pack-saddles for carrying supplies.
7,133	Aparejos saddle sticks
5,170	Boot sticks, used in Aparejos saddles
1,102	Daley ribbings, forming frame for pack-saddle for carrying extra load
44,757	Cincha hooks for Aparejos saddles
8,862	Pack frames, complete
14,014	Pack frame bodies
303,937	Pack frame parts
5,783	Clinch irons, used in shoeing horses
21,584	Wooden bungs for ranges, water kegs, etc.
1,579	Wooden plugs for water wagons
5,613	Wooden buttons for water bags
3,292	Brass drain plugs and nuts, furnished the Submarine Boat Corporation
300	Display frames, for posters at recruiting stations

Miscellaneous Items from Various Car and Foundry Plants

On September 5, 1917, Berwick received a trial order for 5,000 steel helmets. Orders were immediately placed for the necessary equipment and a sample helmet was produced the third week in October. This original order was completed by November 1, at which time an additional order was received for 100,000. By November 21 the daily production had reached 5,000, and this rate was maintained until completion of the contract.

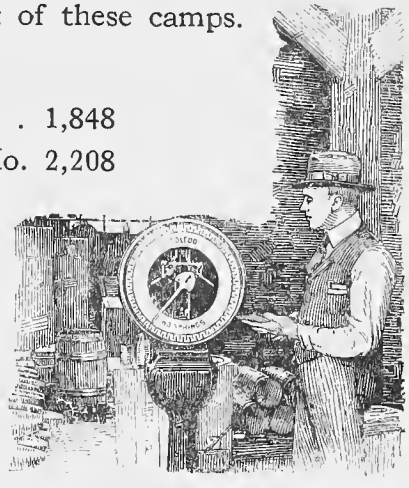
Various orders for smoke stacks and pipe for U. S. Government Cantonments at Chillicothe, Camp Admiral, Md., and Camp Merritt, were assigned to Berwick. These consisted of 6,760 roof jacks, aggregating 92,907 lineal feet of pipe, or a matter of over seventeen miles. A small section of the Car Department was set aside for this particular work, the entire quantity being completed in eight weeks. To complete this work in this time required shipments from Berwick of from three to four full carloads per day.

In addition to building escort wagons, the St. Charles, Mo., plant turned out all the woodwork and chests for the artillery vehicles that were built at Detroit.

This work comprised the following: 2,535 chests for spare breech mechanism; 2,535 chests for spare sights; 2,223 chests for spare cleaning materials; 2,183 chests for spare small supplies; 2,207 chests for miscellaneous spare parts; 9,992 tompions for gun muzzles; 2,207 grindstone frames; 20,800 packing strips; 41,794 pieces of wood lining for forge limber chests; 61,972 pieces of wood lining for store limber chests.

Another of the diversified war activities was the manufacture of cast-iron stoves, which were used for heating buildings at the Army Cantonments in the United States and France. The large foundry facilities of the Car Company made it possible to supply these in quantities to meet the demands of the Army for the rapid construction and equipment of these camps. Of these the following numbers were made:

At Buffalo, N. Y. .	2,282	At Chicago, Ill. . .	1,848
At Detroit, Mich. .	5,537	At St. Charles, Mo.	2,208



FRANK PRESBREY CO.
NEW YORK